

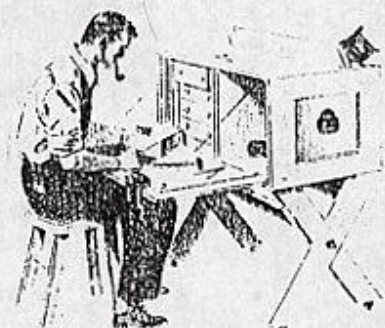
THE SURVIVOR

Volume 9

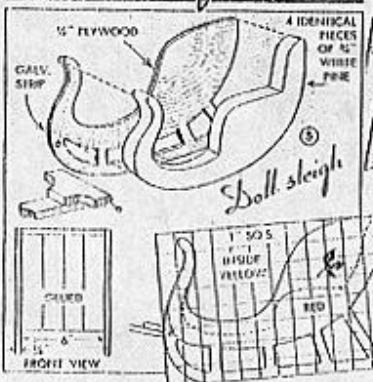
By Kurt Saxon

Treadle-driven, WOODTURNING LATHE

POPULAR MECHANICS
NOVEMBER, 1942



TOYS of wood



A BUSINESS FOR
EVERYONE
MAKING THE LAP
TABLE
APARTMENT WORK-
SHOP
STAY-LEVEL ROCK-
ING HORSE
CERAMICS
MAKING YOUR OWN
TIRE GARDEN
CANDY MAKING
WW 1 TOYS
BUILD THIS KNOCK-
DOWN PLAYHOUSE
MAKE WEAVING YOUR
HOBBY
TREADLE-DRIVEN
LATHE
CLOWN SEESAW
7 CHRISTMAS TOYS
OF WOOD

POTTED PLANT
OR OTHER PRO-
DUCT FOR SALE

FIGURE 4

FIGURE SCROLL-
SAWED FROM 1/4-
PLYWOOD AND
BRIGHTLY PAINTED



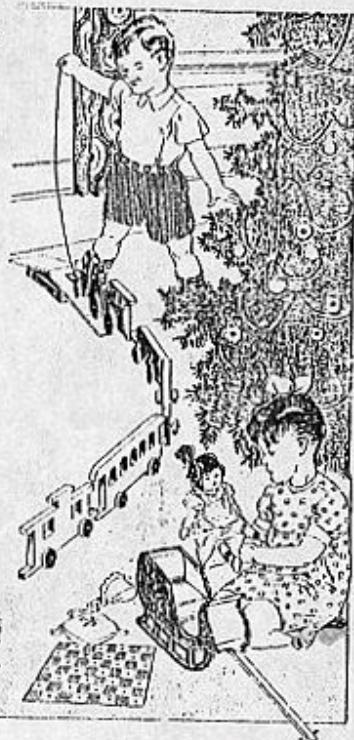
2" SQUARES

Roadside Booths Attract Trade

POPULAR HOMECRAFT JULY-AUGUST, 1939

HI SIBLEY

The novelty of a roadside booth
attracts motorists to stop. We
present several ideas to augment
your income.



A BUSINESS FOR EVERYONE

by Kurt Saxon

If you don't have a business of your own, and a depression-proof one at that, you'd better start thinking about one you can succeed at. You may have a job you think is secure. You may be between jobs. You may be of an age where you fear replacement. At any rate, if you have any awareness of the downturn in our economy, you need to think of how that downturn will affect you.

Our government has taken on commitments which must be honored, even at the sacrifice of our system, our civilization and your children's futures. Our system has up to one hundred million social dependents, and the figure grows and grows, never decreasing. There are thirty-five million welfare recipients, forty-two million Social Security recipients and twenty million or more Federal and State retirees.

Funds set aside for these millions of mostly non-producers are called "entitlements". The hundreds of billions of dollars given yearly as entitlements are added to the National Debt of over five trillion. The debt can grow and grow without worrying most people. However, there is the interest on that debt. It must be paid. It's like your rent and utilities. You pay or you're on the street in the dark.

Soon our government won't collect enough by our present tax systems and other revenue sources. Then they'll really start cutting into the flesh of the economy and then even the entitlements. You'd better start planning.

Such planning should avoid the standard entrepreneurial attitudes about getting money. Such attitudes have, to some extent, gotten our economy into the mess it's in. These are attitudes which ignore production and concentrate on money for its own sake, discounting the need for economic stability.

In 1986 I was invited to speak at a Doug Casey seminar in Aspen, Colorado. It was supposed to be a collection of entrepreneurs, innovators, imaginative thinkers. The people in that room must have represented a hundred and fifty million dollars or more. Yet, as I talked to them and listened to them talk to each other, I could only class them as collectively stupid. If they weren't talking about how to get money through some financial scheme having nothing to do with actual production, their every comment was shallow and uninteresting.

They reminded me of a German moron I had read about. He had paid his taxes and figured out a

simple scheme to get money without producing. I don't remember the figures but let's say the German government taxed at a rate of 10%. They sent him a receipt for say, 1,000 Marks, showing anyone in the financial field that he'd earned 10,000 Marks.

The next year he worked at two menial jobs and lived like a rat to save as much money as he could. He was able to set by 10,000 Marks and sent it all to the government as tax. They sent him his receipt for 10,000 Marks, which was proof that he'd earned 100,000 Marks.

He took that receipt from bank to bank with a story of his prospering business. The bankers could see nothing beyond the receipt and forked over several million Marks in loans. He lived high until caught. I believe the Germans have since corrected their system of tax receipts as proof of earnings.

Many of the Aspen "entrepreneurs" were no more clever than that moron. Each had a gimmick, a scheme, or else a newsletter sold to morons wanting a gimmick. I suppose most of them were legal but the point is, they had little idea of what caused the money; productivity.

I told them they should buy auto repair shops, welding shops, woodworking shops, etc. and hire craftsmen to run them. Check out such places and see how long you have to wait in line to get something done.

No one took me seriously. But I learned a lot from them. I learned that they were helpless and could not survive an economic collapse which would make their paper holdings worthless. On the other hand, those who own and know how to run such shops are raking it in and will do well when our inflated currency sinks to its actual value.

Another thing I learned from them was that their values were casual to the point of fraud. If the money they took in represented a loss to someone else, well, those were the breaks.

The Japanese have a saying: "Success without honor is failure; Profit without integrity is loss". A large part of our economy, and even our government, is run by failures and losers.

People have taken dishonesty for granted for so long that it's hard for some to think about going into business without some angle or gimmick. The idea is to get money. Giving value for the money is secondary, if even considered. Crookedness is accepted at all

levels of our society. The wealthy crooks are heroic and smart. Movies and TV glamorize them.

Of course, our system is coming apart and tolerance by the public for criminality is wearing thin. Soon, the law won't be able to protect the dishonest. So I see a time coming when honesty is not only the best policy, but the only safe policy.

The bound volumes of *The Survivor* detail hundreds of trades, cottage industries and home businesses. One advantage of these is that they are mostly Depression era projects. So many today face the same urgency to become self-employed. Such businesses were set up by hundreds of thousands of previously unemployed workers and managers who had very little money to work with. A lot of the emphasis was even on making their own tools, at great savings.

The practicality of starting a business from scratch is that you learn every step from the ground up. This gives you total control from the start. This will also prevent any dependence on people who may come along to "help" you as the business grows. People who let others do their thinking for them often get helped out of all they own, after they've done all the real work.

Some of the rewards of the system are the development of skills. When you choose items to make and market, it's best to make a sample or prototype. Don't think you have to go strictly by all the old plans. Many have materials no longer used. We have many materials better than used then. Just use the idea and the basic design. Otherwise, fit the idea to your market. This helps develop your natural creativity.

Maybe you've never made anything before. You'd be surprised how hard and easy it is. You follow a plan and everything comes out crooked and weird. You just do it over. The second time you find it's easier and neater. After a few tries you get it right and wonder how you could have been so clumsy with the first model. You've become skilled.

Every succeeding project becomes easier and you find the more difficult projects seem worth a try after all. In time, you can look at most any old diagram and imagine yourself making a marketable product. And at first, you couldn't do anything, remember? Also, you'll see a practical value in many ideas you first saw only as novelties.

Take the lap table on page 3726. Few people have ever heard of a lap table. But once adopted it becomes a necessity. On it you keep all your smaller craft items in a compact space, for working on your bed or while watching TV.

My model has about three square feet of space and holds all sorts of materials for crafts and hobbies

and for putting together your ideas. It's also for art work, sewing and just about everything you want to use it for. You don't have to gather up all your supplies each session or keep them on a table to themselves.

This way, you have everything together and can move the lap table around as needed and then set it out of the way on a shelf when not in use.

It will teach children organization and neatness. It will also relieve the burden of mothers who yell at the little hobbyist to clear the table to make room for supper.

Working this project will do several things for you. Maybe you've never done anything you weren't told to do. The biggest part of maturity is being self-directed.

Making a simple lap table will show you that you can make something others want. It will give you confidence that you can gain skills you thought only special people were born knowing.

And if you can do this simple project, you will prove to yourself that you can master more complex projects. But the biggest thing you'll learn is that most people can't do anything unless someone else tells them to do it. You'll realize you are apart from the herd and above it. You won't be afraid that you and yours will have to suffer along with those who look to others for direction. It might even frighten you at first, but you'll soon realize that we aren't all in this together.

First, understand that my program is risk-free and no waste. If you have to buy the tools, they'll be tools you should have and will use often. The materials you use to make the projects are affordable even if you're on welfare. Say you buy the materials to make three lap tables. You keep one and use it to work out more projects. The other two you give as gifts, which you would have to have spent more on. You can't lose.

When you've made all your mistakes on the first one, which you keep for yourself, the next will be much neater and the third will be good enough to show around at gift and hobby shops or whatever market, such as hospitals, rest homes, schools, colleges, etc.

If you can't afford the shop machinery to mass produce, look up a woodworking shop and contract a dozen, where they should be cut, and drilled for about \$2.00 a unit or less. Wholesale them for \$8.50 or retail them for \$15.00 and you'll clear a profit of from \$3.50 to \$8.50 each. With the right presentation, you'll be selling them by the hundreds.

After selling a few dozen you'll be able to afford real shop machinery and can turn them out at the rate of about

thirty a day. With that machinery, you can tackle bigger projects and you'll have your own woodworking shop and independence.

Once you learn you can do something, you don't have to limit yourself to working with wood. You have a choice of hundreds of trades, starting with projects as simple as the lap table and branching out. Then you'll want to fix on a line of business which will always be in demand, now and in a probably bleak future.

Picture the economy getting as bad as you can imagine. What will people need? Just leaf through the bound volumes of *The Survivor* and you can come up with hundreds of choices, any one of which will make you a community asset.

Even if you don't care to become really skilled and so don't care to make more than a prototype, you can hire others. You can either set up your own shop or farm the work out to people already set up.

When I designed the Kountry Kitchen Food Dryer I made only one and then turned the making of the rest over to a local woodworker. He turned them out ten at a time for \$25.00 apiece. I was selling them for \$55.00.

Then I got the 1943 plans for a better model based on the same principle which the reader could make for himself. (See Vol. 8, page 3360). I could hardly publish the plans for that and still promote a lesser model. Publishing such knowledge is my top priority.

Incidentally, you could make this dryer, or have it made and sell it for \$100.00. It's better than any dryer on the market. Also, you could use it yourself to make jerky, dry fruits and vegetables or herbs and sell the products.

As you plan your business, don't build images of drawbacks. Make your product for your own use first. Then try it out on your friends. Find a market first and then consider any legal angles. Worry about licensing and such only after you start to make a taxable profit. Then consult your local Chamber of Commerce. They'll advise you about any licenses needed in your area.

Whatever you do, don't ask anyone's permission to make and sell a product. If you have to deal with a bureaucrat at any level, never ask if it's legal to do what you're doing. You'd be surprised at how the usually, mindless bureaucrat will dig and search and find some restriction.

Instead of asking, tell the bureaucrat what you're up to and request any licensing forms for such a business in your county. I've never even done that and I've never had any trouble. Of course, I've made sure to get a state business license, but not before I was doing several hundred dollars a month in business.

So don't worry about anything but perfecting your product and you won't have anything to worry about.

Don't even worry about marketing. We'll deal with that later. Just remember, if you can make something or grow something and it's good, someone will buy it. And give this some thought; the only difference between a person who works for someone else and one who has his own business is persistence.

If you've been the kind of person who will try something and then give up on it before you get it right, I'd like you to think very carefully on Ray Krok's philosophy. He founded McDonald's restaurant. That guy just kept on until now he's one of the world's richest men.

What he did was basically very simple and that was just keeping on. He wrote down his philosophy and one of my readers sent it to me. I want you to ponder it and then apply it.

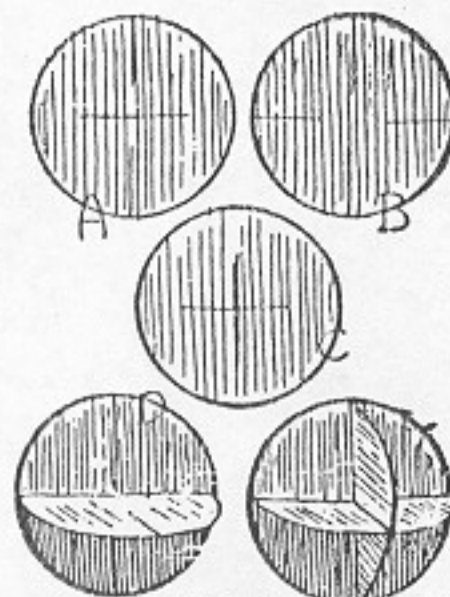
"Press on. Nothing in the world can take the place of persistence. Talent will not. Nothing is more common than unsuccessful men with talent. Genius will not. Unrewarded genius is almost a proverb. Education will not. The world is full of educated derelicts. Persistence and determination, alone, are omnipotent".

Now that's it in a nutshell! Throughout all *The Survivors*, if you've read them, you've found that the people who really succeed are the one's who take a simple idea, something that fills a need, and work on it until they know how to do it right. Then they go out and promote it, whether it's word-of-mouth, door-to-door, advertising in magazines or whatever. You can do it but you've got to do it instead of just fantasizing about it.

So persist. Your future may depend on it.

A BALL FOR WINDY WEATHER

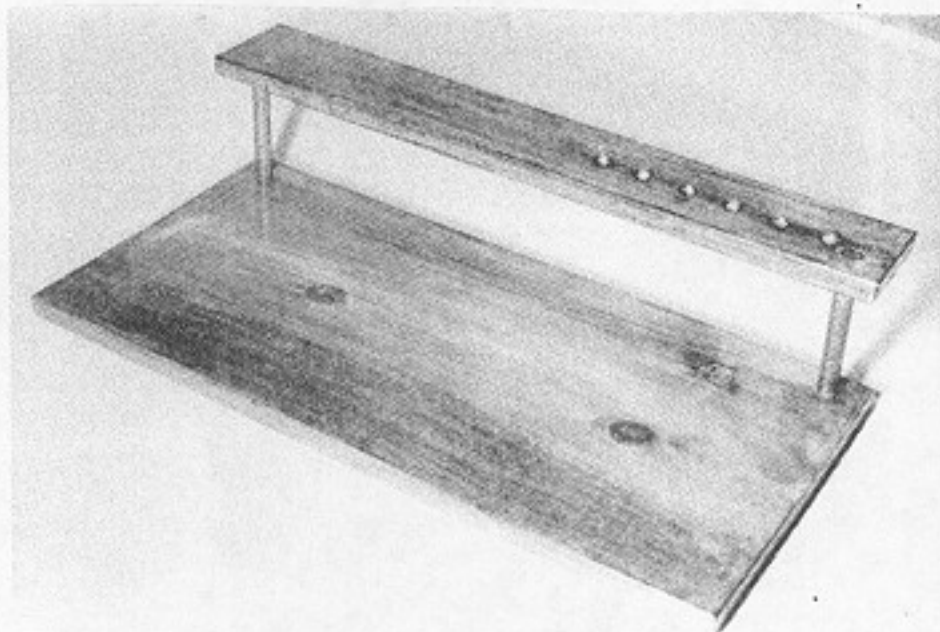
This little paper ball will refuse to keep still if let loose on a windy day, as long as it can roll and tumble and scurry forward on a smooth surface, such as is provided by your school playground or the dry sand on the beach at the seaside. It will give you endless fun, especially if you and your friend make one each and have races.



Cut three circles as shown in A, B and C. Fit A into B (see D) and then complete the finished ball, E, by tucking in C. Make each circle an inch and a half in diameter and use stout drawing paper. It is not a bad idea to colour the circles and sides with different bright paints.

MAKING THE LAP TABLE

by Kurt Saxon



This simple project will teach you the basics of woodworking and could lead to a lucrative and pleasant career. You'll learn how to select wood, then saw, finish and stain. After you've made three lap tables, you'll realize the third was done so much more quickly and so much neater than even the second, that you can tackle anything. Just knowing you can do something and do it well will assure you that you can make a living through your own efforts.

Your finished lap table will be a very good-looking piece of furniture which could pass for a 100 year-old antique. It is also very simple to build. Any amateur or older child could turn out a professional-looking job with the very first model.

MATERIALS FOR THREE

Six feet each of 1x12 and 1x4 soft white pine, shelf grade.

One 5/8 inch yard long dowel.

One quart of Red Devil Polyurethane High Gloss #64 Walnut Stain.

Small container of Elmer's Carpenter's Wood Filler.
Small container of Elmer's Carpenter's Wood Glue.

TOOLS

Hand saw, saber saw or circular saw.

Hand drill with disc sander and coarse 50 grit sanding discs.

5/8 inch wood drilling bit.

Finishing sander and pack of medium sanding sheets.

Putty knife.

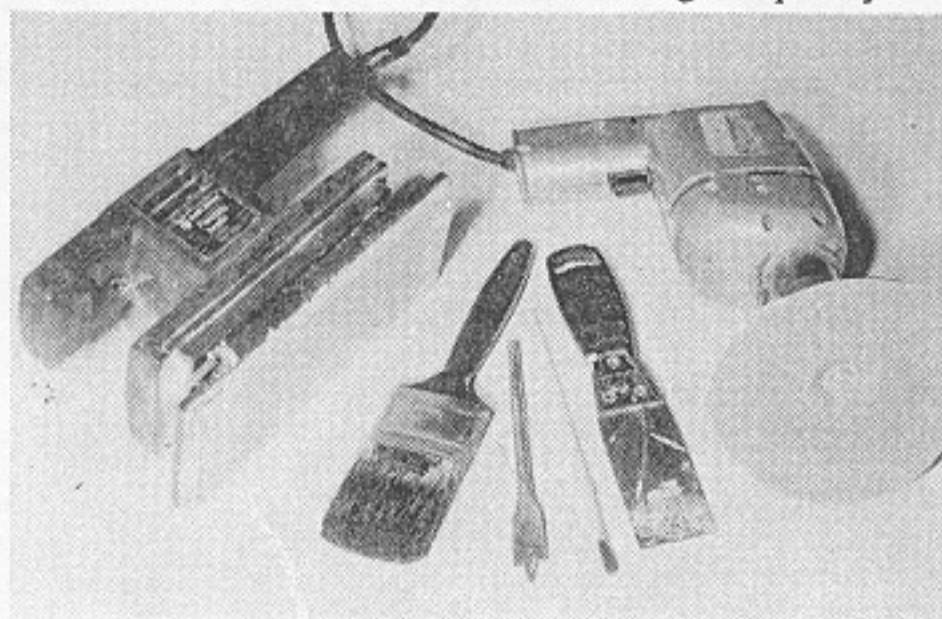
Paint brush.

Cheap artist's paint brush.

All the materials and tools will cost around \$100.00. Except for the wood, everything else will be used for many more lap tables and other projects. Besides, you should have all these things if you want to learn to take advantage of all the opportunities coming at you through Shoestring Entrepreneur and the bound volumes of The Survivor. There is no loss or waste in this program.

Ideally, you should have a drill press, a bench grinder, a router and a paint sprayer. You should order a free catalogue listing every shop tool you can think of, from Harbor Freight Tools, 3491 Mission Oaks Blvd., Camarillo, CA 93011 (1-800-423-2567).

They have just about everything you'll need for a well-equipped shop. They are even cheaper than Wal-Mart and most of their tools are of a higher quality.



But in the meantime, the tools suggested above will serve until you have a marketable product. If you decide to mass-produce your products, rather than contracting them out, you can equip your shop with the profits you get from your first project.

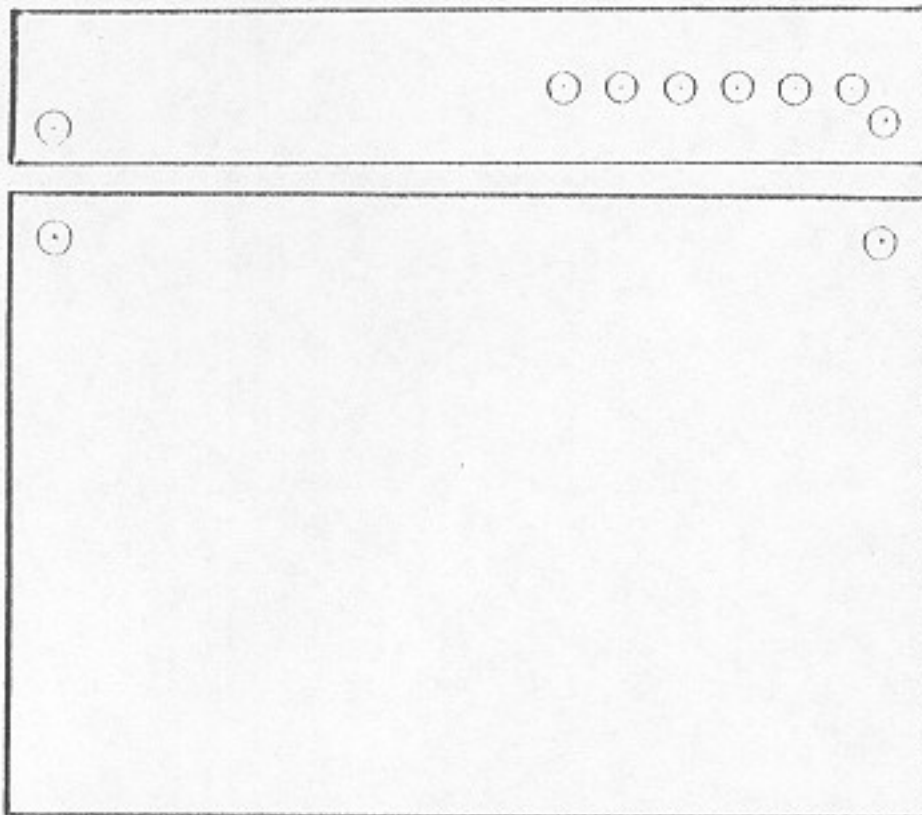
Keep in mind, you are not to go all out investing in tools as you fantasize becoming a factory owner. Buy the

more expensive tools only after you have a market for more products than you can produce with a few simple tools.

Your first step is to saw the boards. You should have a saber saw. It's not expensive and is so much faster and can saw curves and such. But a hand saw will do to start.

I suppose you already know how to measure two feet and draw lines across the boards as a guide. Well then, saw. Now check the boards for the smoothest and best looking surfaces. Leave the least perfect sides for the bottoms.

When the boards are sawed and inspected, you drill. Draw a faint line down the exact middle of the 1x4 inch board. Measure two inches from the right side and make a dot. Then measure 1 1/2 inches from the dot and make another dot. Make six such dots.



Now measure 1 1/8 inches from each side of each of the lower corners and make two more dots. Now go to the large board and do the same to its upper part. Then drill 5/8 inch holes at the dots. When assembled, the tool-holding holes should be on the right and part of the 1x4 should project over the 1x12.

Next put a sheet of medium sandpaper on the sander. Turn it on and run it along the top edge and corners of the 1x4 until it's neatly rounded. This takes only a minute and is easy if you're careful. Do the same with the large board, but around both top and bottom to prevent sharp edges on the bottom from causing discomfort when held on your lap.

Then inspect the tops of both boards for cracks, dents, etc. Use your putty knife to force wood filler into any cracks or other imperfections. Press firmly so no wood filler remains outside the imperfections. Let it dry for a couple of hours.

Now run your hand over the boards to feel for any

rough spots. Run the sander over them gently so you don't dig into the boards and also sand over any spots you've put wood filler in.

When the tops of each board and their edges are sanded smooth, brush off any dust and apply the stain. Staining is the easiest way of painting. You just slop it on and it sinks in and stains. Of course, you go over any spots where there is too much stain before it dries. Use the artist's brush to get down into the six tool holes.

After you've covered the tops and sides, go back over the sides to smooth out any drips. After a few hours, go back and hit any spots that look dull. What you want is a rich, glossy finish. The stain does most of the work and touching up here and there will give even an amateur a professional-looking job. A nice thing about this kind of stain is that the more you mess with it, the more antique it looks.

Don't bother painting the bottom of the boards. They won't be seen and there's no sense in wasting stain or time.

Now for the dowel. Stain the dowel its entire length except for an inch to hold on to. When it's dry, cut it into 5 1/2 inch lengths, starting at the painted end and leaving the unpainted end as the waste piece.

The ends of the dowels must be ground slightly smaller since too exact a fit may cause them to split the boards. This is no trouble. Just mount the sanding disc to the drill and project it over the edge of a table. Then twirl the dowel between your fingers and let the grinder take off about 1/32 of an inch for about an inch down on both ends.

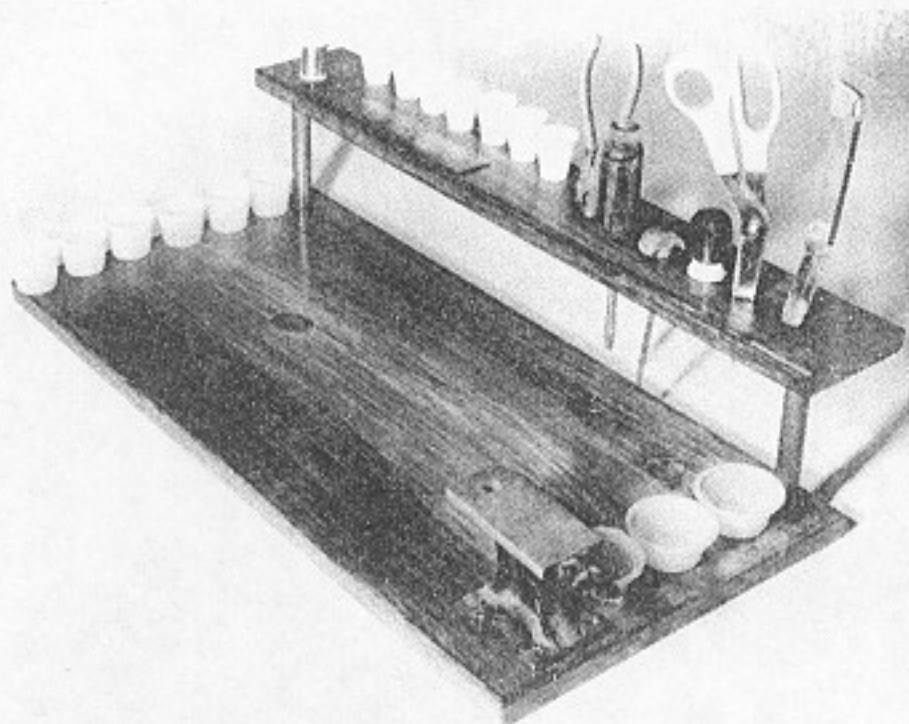
When you have the end of the dowel bare of stain, that should be enough. When you've ground the ends of the six pieces of dowel, dip those ends in the stain, then give them a flick into the stain can to save the excess stain or wipe off the excess with a rag and let the dowels dry.

If you've been careful at grinding the dowels you'll have to force the dowels into the boards but without pounding. If you've ground too much you'll need the glue. Just smear a couple of drops near the ends and put them in the bottom board, then put on the top board and make sure the ends don't project from the top board or beneath the bottom board.

If there is a gap between the dowel and the board, you might force some wood filler in around the dowel and use the artist's brush to touch up with some more stain.

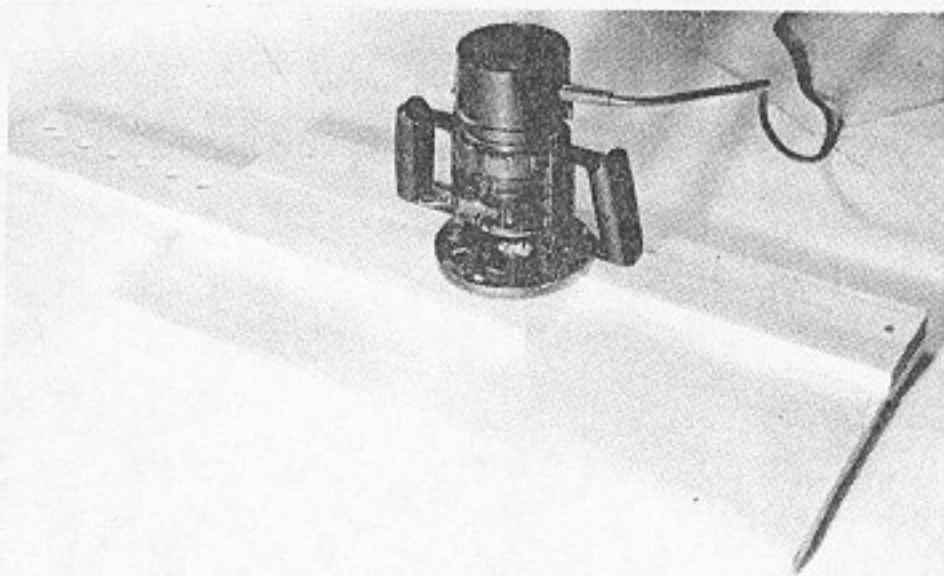
For your own use, or when demonstrating the lap table, you can get some double-sided Scotch Tape for holding all sorts of containers to the bottom board or the shelf. In this way you can attach small plastic cups or boxes to hold paints, buttons, parts, etc. This will give you a complete hobby-craft workshop which can be put

up out of the way, keeping everything in place and ready for use.



If you decide to make these lap tables by the dozens you'll want to use a router to trim off the sharp edges. Rather than spend a lot for a routing table, you can make an inexpensive jig which will do just as well. You can get a router from Wal-Mart for around \$45.00 plus a 1/4 inch corner router bit for \$5.37.

The router jig is made from a 1x4 and a 1x12 board. Use your 5/8 drill point to cut a notch in the middle of the 1x4. To do this you place the 5/8 drill in the middle of the upturned side of the 1x4 and drill about a half inch. The notch is for the router bit.



Then nail the 1x4 onto the 1x12. Place the router so the bit is half way into the notch. Then position a loose 1x4 board under the router and right alongside the 1x4 router board and push it toward the router bit. When you can sight along from the other end and see that the router bit will sheer off the corner neatly, mark around the router body and, with a 3/16 drill, drill two holes down through the holes in the router resting on the 1x4.

Bolt it fast with two 2 1/2 inch long 3/16 bolts and nuts. If it doesn't cut perfectly, make another notch on either side of the first and try again. You should get it right on the first or second try.

When you get your router and jig set up and tested with scrap 1x4 inch boards, you're mechanized. You then just push the boards alongside the 1x4 and past the router and it goes as nice as any expensive setup.

A FLYING HELICOPTER

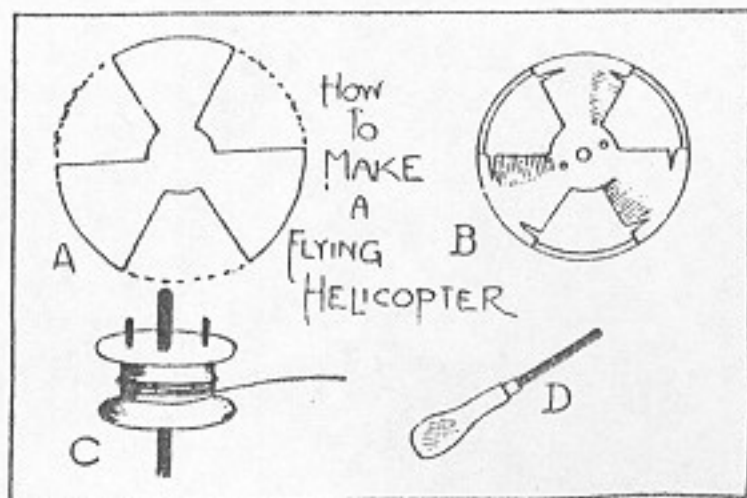
Perhaps you do not know what a flying helicopter is like. It is a winged device which, when spun, soars high into the air. Great fun can be derived by seeing to what heights it will rise. You can make one fairly easily and it will provide you with hours of enjoyment.

Get a circle of very thin tinned iron. Just the thing for the purpose is the airtight cap which is cut out of a tin of fifty Gold Flake cigarettes. Having procured the metal sheet, cut it into a circle, and pencil the outline of three propeller blades, then shape them with scissors, as shown in diagram A. Now, take some stout wire that will not easily bend, force it into a circle, slightly smaller than the original circle of tinned iron, and solder the ends. The next thing is to place the propeller blades centrally on the ring of wire, turn the projecting ends over the wire, and

solder them neatly. This done, make cuts in the blades, then bend them at an angle and pierce the centre with three holes. Diagram B shows exactly what you must aim at.

Three more little articles must now be contrived. For the first, take an empty cotton spool, and put in it two pegs at such a distance apart that they will fit into the two outer holes in the propeller blades. These pegs can be made easily by cutting inch lengths from the stout part of two large French nails. (Diagram C.) The second article is a holder. For this procure the wooden handle of an old screw-driver, and, instead of the ordinary piece of metal, insert a rod of iron, six to eight inches long. See that it holds firmly in the handle, and is of a suitable gauge for running through the centre hole of the propeller blades. (Diagram D.) The last requirement is a length of cord.

Now for the way this little contrivance works. Hold the handle of the screwdriver in the left hand, drop the spool on to the rod, and place the helicopter on to the top of it. Now wind the string tightly round the reel and then pull firmly. The metal wheel will rise off its seating rod and soar up into the air. By winding the cord just tight enough, and pulling with sufficient strength, the blades will rise to a great height. Note that the contrivance should not be held quite vertical, but tilted slightly away from your person, in order that it may not dash against you. See also that nobody is standing in front of you! Keep your onlookers at your side, or well in the rear. Only use the apparatus in a big open space.



THE BUSINESS OF FOOD

by Kurt Saxon

A while back I watched a TV segment on families in reduced circumstances. These weren't the really poor; just some who had lost a major part of their income.

The most memorable was a couple with two children who had both worked and the husband lost his \$28,000 a year job due to a physical injury. He had to take a job helping the mentally handicapped at \$15,000 a year. The wife still had her job as a secretary at \$17,000 a year. So with a \$13,000 reduction of their wages they had only \$10.00 until Thursday.

Even with a combined income of \$27,000 a year, here was a family of four who could barely make ends meet. Obviously these people were totally locked into the system. The system dictated their life-styles. On their dinner table were bottles of soft drink and I'm sure their food was preprocessed, right off the supermarket shelf, just as the TV commercials suggested.

Of course, they would be paying on as nice a home as they could have afforded, as the system had promised. Surely there would be two late-model cars in the driveway, unpaid for. Ten dollars until Thursday. Then what of the next Thursday?

They're in a rut I don't think they'll get out of. They'd planned and spent all their income on the highest level of life-style they could afford, trusting their health and the system. If and when the system fails, what will they do?

What will you do? To put all one's eggs in one basket, even in the best of times, has been the ruin of many. As our system declines further, no one will be spared the challenge of lessening their dependence on the system. Best to start now, and at the same time, you might as well make your lessening of dependence profitable.

Food should be your primary consideration. Aside from rent, it's the most expensive part of your budget. If you must eat as dictated by TV commercials and habit, any change in your job status could mean actual hunger.

But if you can process your family's food from the basic foods; grains, fresh vegetables and meat as flavoring, rather than the main course, you can cut your food bill by three quarters. Don't kid yourself with the idea that you don't have time. You make time for what you consider most important. Saving money on food for economy, as a way to finance a home business, to insure your family's health is very important in these days of insecurity and polluted commercial foodstuffs.

Besides, preparing food, when part of your routine, becomes easier and quicker with acceptance and practice. Take bread for instance. Bread costs as much as

\$1.50 a loaf. Yet, you can bake the same weight loaf for about 30¢. It also tastes better, is more nutritious and more filling. Moreover, while busying about the kitchen, its preparation isn't very time-consuming.

As for cheapness of food, imagine going to a Chinese or Mexican restaurant. That's a treat. But have you ever considered what goes into the usually expensive meal? Mainly rice, corn, beans, vegetables and maybe about an eighth of a pound of meat. You can be sure the restaurant owner got the ingredients for under 50¢ per meal.

Of course, there was overhead and employee wages, lights, energy, taxes, etc. You could eat as well at home for well under 50¢ per family member. A family of four could eat very well for under \$25.00 per week.

Regardless of what restaurant you might go to, whether American, Chinese, Mexican, Italian, etc., you're paying from five to ten times what the meal would cost homemade. If you like the food, prepare it yourself, cheaply.

Take corn, for instance. If you have a Corona Grain Mill you can buy corn for \$3.50 for 50 pounds. Ground fresh, cornmeal costs only 6¢ a pound as opposed to 28¢ a pound in the store. You can make cornmeal mush for 4¢ a pound. Cornmeal mush in quarter inch slices and fried is delicious, nutritious and filling. Served with bacon and eggs it's as fine a breakfast as one could want.

Cornbread and beans is a delicious, filling and healthful meal in itself and costs hardly anything. Boil two cups of pinto beans in eight cups of water until soft. A few strips of bacon cut up in the beans wouldn't hurt. Then ladle out a generous pile of beans with their rich soup over a slab of cornbread and sprinkle with chopped onions, add salt and pepper and you have a meal fit for a king.

Cornbread and corn pancakes, as well as cornmeal mush have long been staples in the American south. In Italy, cornmeal mush is also a staple food and is called polenta. Corn is cheap, very nutritious and tasty. There is no reason why this inexpensive and very easy to prepare food shouldn't make up a part of everyone's daily menu.

Then there's tofu. It's served in Chinese restaurants and is the light-colored stuff with the consistency of jello. It doesn't have much taste but absorbs other flavors. It's a staple food in the Orient and has as much protein as hamburger. It costs up to \$1.50 a pound in the store but you can make it for about 30¢ a pound.

Corn, beans, wheat rice and fresh vegetables make up the bulk of the diets of Third World peoples. Third World diets, if adequate, are just as nutritious, and

usually more flavorful than ours. And really, the main difference is that theirs are prepared in the home instead of being bought in packages, cans, jars, etc.

So food preparation is your key to economy and the main difference in the diet is using meat as a flavoring rather than as a staple. Also, although some meat in the diet is good for you, it isn't a necessary staple, and as such, is an awful expense.

Anyone who can cook and knows the use of herbs and spices can make any inexpensive staple tasty and acceptable to all family members. If you don't know how, learn.

Another useless expense is milk. Mammals don't need milk after weaning. Children should be breast-fed until weaned. After that, milk, as such, is unnecessary. You may not realize it but America's obsession with milk is a result of non-weaning. The baby's bottle, then the child's glass of milk, into adulthood. If you still drink milk you've never been weaned.

Then again, there's always soy milk. It can be made for under 30¢ a gallon. It isn't as rich as cow's milk, except for protein, but much more filling. Chocolate or strawberry flavoring will make it acceptable to any child and it serves most purposes in cooking and baking.

The processes for tofu, soy milk and soy bean sprouts are on pages 251-4 of The Survivor Vol. 1

If you are trying to lose weight, soy milk will do it effortlessly. It's very filling. One full glass will really dull your appetite. Better give the kiddies a smaller glassful or they won't finish their other food.

As for soy bean sprouts, well they are the most nutritious of green vegetables and cost under 20¢ a pound.

Learn the simple processes for preparing these foods and you'll not only save money and feed your family better, but you'll develop skills you can apply to food production to sell or even to start a family restaurant.

Aside from food preparation, there's the matter of growing it. If you have any sort of yard, you can grow all the vegetables your family will need in ten tires from the larger cars. With the top of the tire cut out at the rim of ten such tires you have sixty square feet of raised beds. Plants can be spaced more closely, producing more and shading out weeds.

By planting more seeds in planters about a month before harvesting the beds and then transplanting as the spent plants are removed, up to six crops can be grown in a season. Tires are free and last forever. The only expense is the soil, which is permanent, especially as it is fed with spent plant matter, kitchen scraps, etc. (See Making And Selling Tire Gardens, **PAGE 37**).

If you have room there is no reason you couldn't have a hundred or more tires producing commercially. A

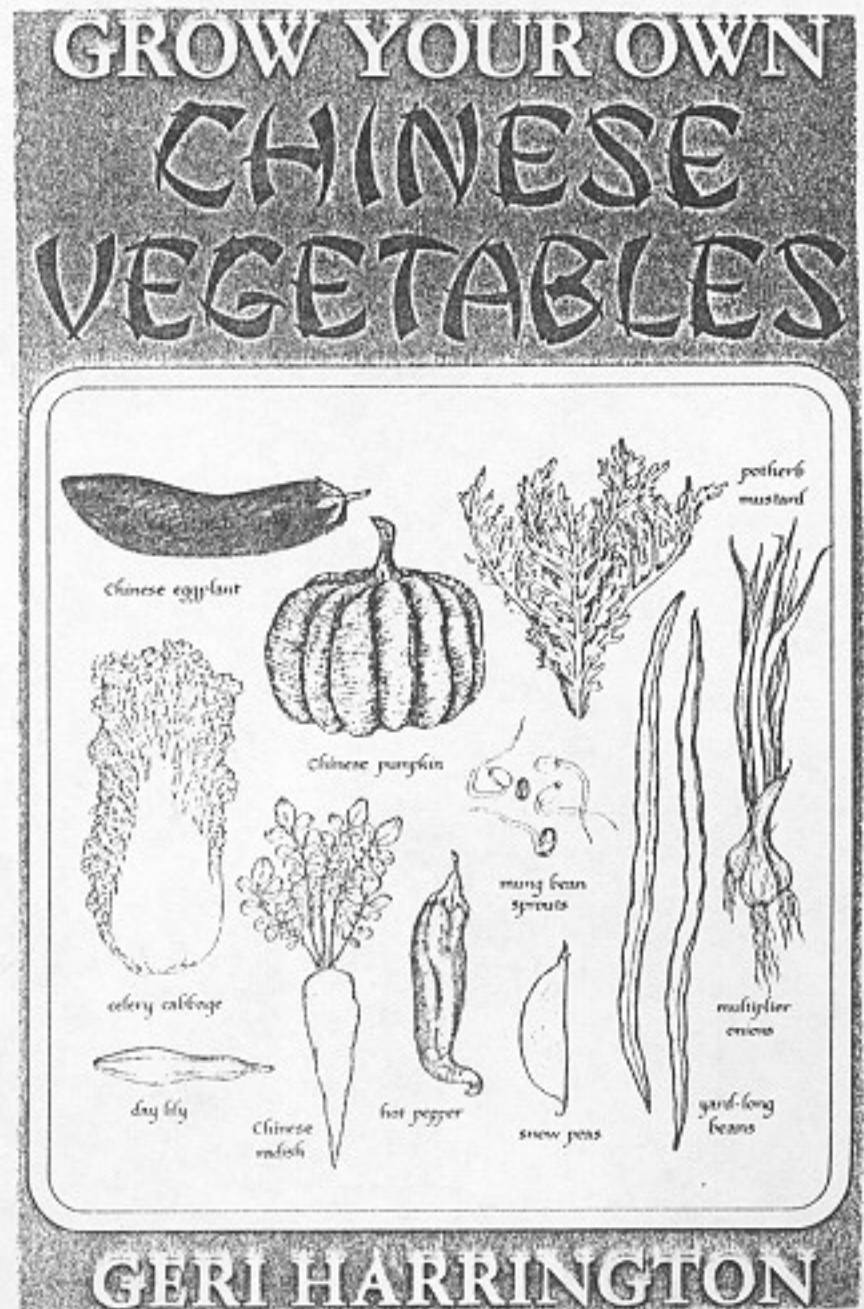
pickup truck with a frame built in its bed for holding vegetable boxes could be used for a profitable vegetable route.

You could put a 6 x 6 inch display ad in your neighborhood paper. If you live in a large city you wouldn't advertise in the city paper. You'd use the local paper or the throwaway kind which covers a relatively small area.

The ad would announce that you will sell harvested fresh daily, vegetables 30% lower than the store prices. Since you would have little overhead, your profits would be high. Right away, you'd begin getting calls from all over the neighborhood. Early next morning you'd harvest, pack the truck and make the rounds. You'd sell all you could grow. After a couple of weeks advertising you'd have enough customers, plus word-of-mouth, that you'd never have to put in another ad.

The foregoing is for common vegetables such as tomatoes, cucumbers, squash, corn, etc. You might want to specialize. If you grew only tomatoes or two or three other vegetables, you might grow only to supply stores or restaurants.

If you really want to specialize, Chinese and other Oriental vegetables would be a sure profit grabber. If



AMERICAN COOKERY

October, 1934



Chinese vegetables. They're luscious, easy to grow, healthful, and fit into both American and authentic Chinese dishes. And they're getting more popular every day.

But they can be confusing. Chung Gwa. Is that a bean or a melon? How do you find the seeds, grow and harvest the vegetables, cook and serve them best?

This book answers those and all your other questions on Chinese vegetables. The author gives the American, Chinese, and botanical name for each one, describes it, tells many uses for it, and explains how to grow, harvest and cook it.

Forty vegetables including:

Sweet melons
Chinese cucumbers
Adzuki
Fuzzy gourd
Chinese lotus
Yard-long beans
Chinese radishes
Sesame
Giant garlic
Hot peppers

\$12.95

there isn't a local supplier, and there usually isn't. Oriental restaurants in your area will buy all you can produce and contract for all you can grow. Supermarkets are also adding Oriental vegetables for their many shoppers turning to Chinese foods.

The book, "Grow Your Own Chinese Vegetables" gives full coverage to the field and will give you not only descriptions of the vegetables, but planting instructions and sources for the seeds.

Remember the couple at the beginning of this article? To start a business, aside from learning the arts of food and saving hundreds of dollars, the husband could have stayed at home taking care of the kids and starting a business.

Had the wife been making less, she could have stayed home. This would have saved a lot on clothing, transportation and maybe even nursery school.

The volumes of The Survivor have hundreds of home businesses. Any intelligent man or woman can find a suitable home business in The Survivors and with the proper motivation can soon make more than any outside employer is willing to pay.

A plus, aside from the expenses demanded by work outside the home, is tax breaks. The work area is deductible off rent or house payments. Electricity, materials costs, etc. are also deductible. This is so even before a profit is made.

So begin thinking of starting a home business. Any couple with average intelligence can soon develop a trade which will employ both, and maybe even the older children.

QUERY No. 5265. — "Can you help me locate an old-time recipe for what we used to call 'Puffles'? As I remember them, they seemed to be made of Italian Paste, shaped into a roll and cut in thin slices. When needed they were fried in hot fat and expanded to a crisp delicacy."

Fingerhuetchen (Noodle Puffs)

We hope that this is the recipe you wish. Prepare and roll dough as for noodles. Let stand until almost dry, fold dough over through the center and cut through this double thickness with a small floured cutter or thimble, pressing well so that the edges stick together. Fry in hot fat until brown. They should puff like little balls. Place in a tureen, or in a bouillon cup, and pour the hot soup over them.

Noodles. Beat one egg slightly, add one-half a teaspoonful of salt and enough flour to make a very stiff dough; knead, toss on a slightly floured board, and roll paper-thin. Cover with a towel and let stand at least a half hour to dry.

QUERY No. 5271. — "Can you supply me, please, with a recipe for homemade tabasco?"

Homemade Tabasco Sauce

Chop fine four dozen red tabasco or chile peppers and one clove of garlic. Boil until tender, drain, and rub through a sieve. Add to the paste enough spiced vinegar to make it of creamy consistency, bottle and seal. Onion may be used in place of garlic, if preferred.

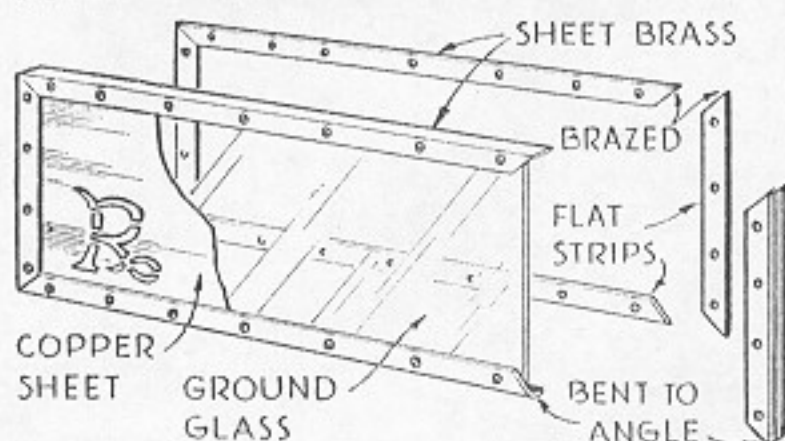
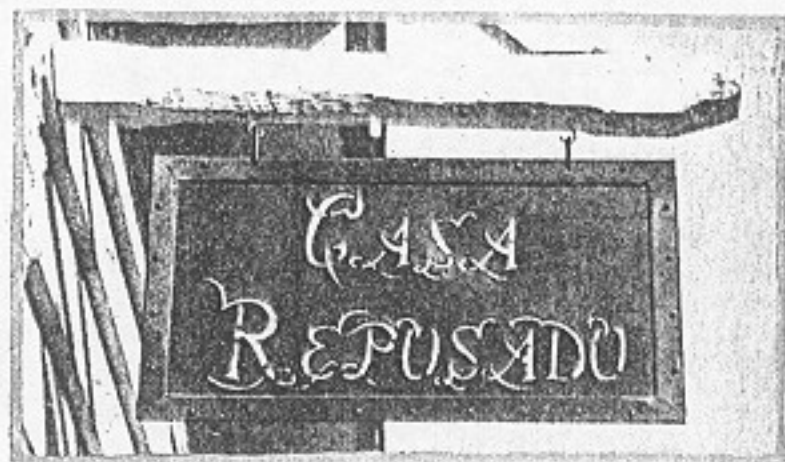
Spiced Vinegar

To one quart of vinegar, add one-half a cup of sugar, one tablespoonful each of celery seed and mustard seed, and one teaspoonful each of salt, ginger, cloves, cinnamon, and allspice.

Picturesque Signs

DESIGNED TO CATCH THE EYE

POPULAR SCIENCE MONTHLY JULY, 1937



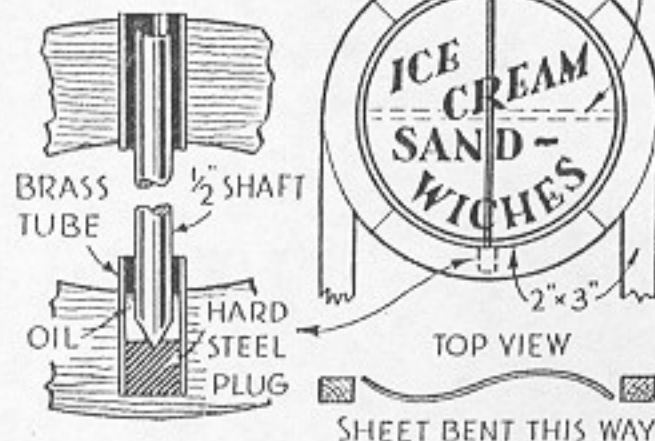
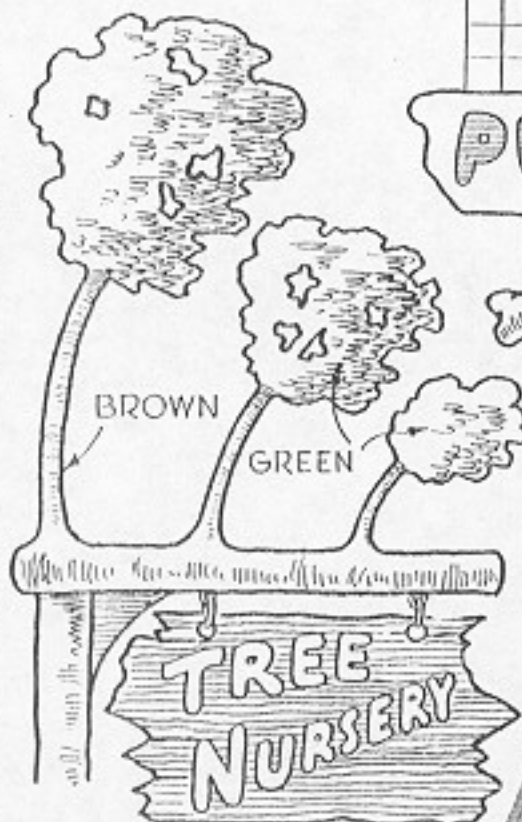
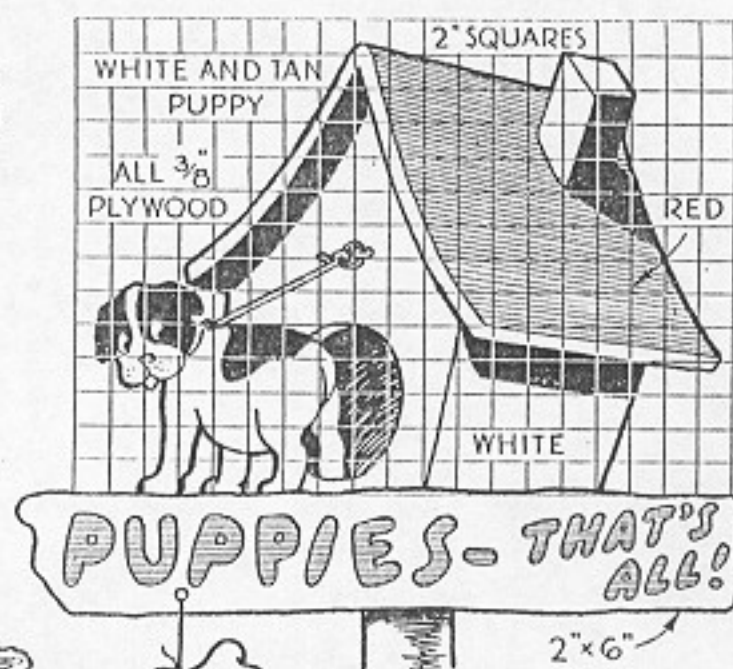
A cut-out metal sign backed with ground glass, and seven other equally novel ideas

SUGGESTIONS for a variety of decorative modern signs are given in the accompanying illustrations.

Signs in brass and copper like the one above lettered "Casa Reposado" can be adapted to a wide range of uses. The lettering is cut with a cold chisel in sheet copper, the work being laid flat on an upended block of hardwood.

A sure-fire attention getter for anything nautical is a large wooden anchor in aluminum finish on a white post, surmounted by a ship's lantern. Another idea for the shore or wherever the sea is to be suggested is to use a conventional wooden sign but form the letters from bits of cotton rope.

The puppy sign in the upper right-hand corner is merely a plywood silhouette rabbeted into a 2 by 6-in. plank and mounted on a 7-ft. post. The chef also is a silhouette, painted the same on both sides. The menu card slips between glass panes in a frame.—Ht Sibley.



Making and selling tire gardens

By Kurt Saxon

Raised beds are the best way to garden, for several reasons. First, the plants are closer together so there is little weeding and greater productivity. Since they are several inches off the ground there is less stooping. The drainage is better. You supply the soil so there are no rocks, and you don't have to dig or plow the garden. Raised beds are usually a series of small garden plots which can be put here and there wherever there is a few square feet of space.

The drawback is that they are expensive. Like with railroad ties, which are costly and waste a lot of space in wood. Even 1x10 wooden boards cost a lot and unless specially treated, they rot. Then there is all that sawing and carpentry getting them together.

Tires are the answer. A standard P235/75R15 tire has 6 square feet of growing space when you cut out one side right up to the tread. It gives a bed 8 1/2 inches above the ground. A P215/75R15 tire is 6 3/4 inches above the ground and has less planting area so the P235/75R15 are your best choice.

If you are husky you can use a strong, sharp hunting knife to saw around the tread in about five minutes. But first you must use a quarter-inch drill to make the starting hole.

Your saber-saw will need a wood-cutting blade with 10 teeth to the inch. For faster cutting, grind both sides of the blade, leaving the teeth, but very thin. This will cut through tire rubber like butter. It's fun.

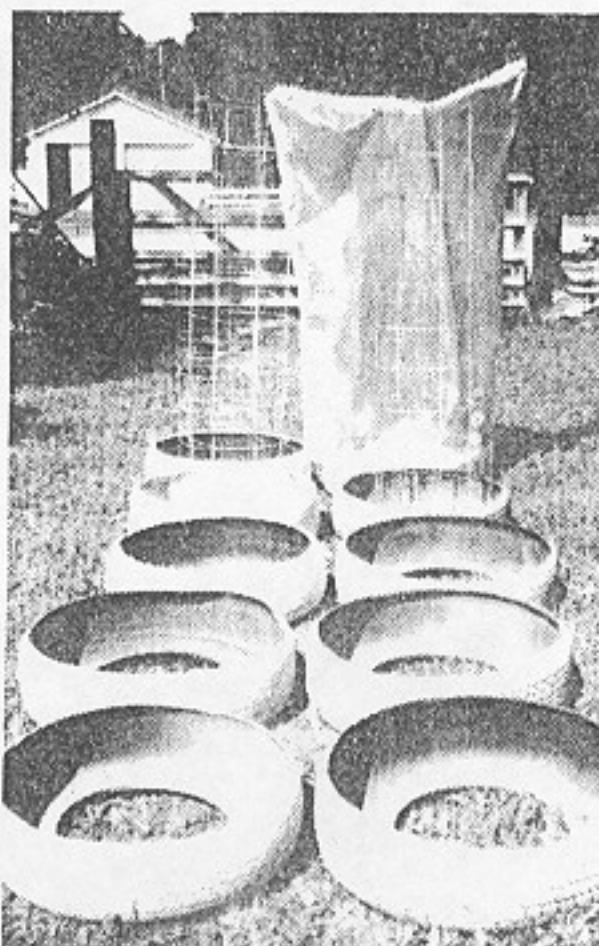
Leave the other side alone. Deep-rooted plants will go through the open space into the ground, anyway. The bottom side acts as a reservoir, holding several quarts of water, which will come in handy.

Many places selling tires will get charged a dollar a piece to dispose of them. They don't want them. They're

free. Go to your Tire World, or such in most towns and take your pick from great piles. They'll bless you for taking them away.

Any business selling and mounting tires will have a stack in back you can have. Here you can take your pick of truck tires a foot and a half thick with ten square feet of space with the side cut out, to standards, compact tires, on down to little bitty tires from three-wheelers.

Compact tires make neat little beds which could be put on decks, porches, along walks, etc. They are perfect for herb gardens. A novel way would be to paint them in pastel colors and letter them "Catnip," "Thyme," "Marjoram," "Parsley," "Chives," etc. Most homeowners seeing them would want a set. A profitable use for tires from three-wheelers would be hanging baskets. These are often expensive but those made from three-wheeler tires would cost almost nothing. To make one, cut out the side at the tread and drill four holes with an eighth inch drill a half



Ten-tire garden

inch down the tread. Then cut two strong wires; their length depending on your need. Push the end of one wire from the outside to the inside and back out the next hole. Do the same with the second wire and pull both wires taut. Then bring them together above the tire and twist them into a three-inch strand and bend it into a hook.

Cut a circle from one-inch chicken wire to fit the bottom inside of the tire. Then layer the bottom with grass or straw and fill the planter with soil. Now put in the plant and hang it up. These would be especially good for growing cherry tomatoes on your patio.

But we're mainly interested in real gardens. Say you have a regular garden space. You'd put P235/75R15 tires all around the fence. The spaces between the tires' curves and the fence could be layered with straw, wood chips, etc., to prevent weeds from growing back there. Weeds in front could be dealt with by using any weed-eater as the tires would not be harmed and the plants inside would not be in range. Actually, the walks between tires should be spread with wood chips or gravel to eliminate weeds altogether.

A good thing about the tires is that they will never disintegrate. So what makes them an environmental nuisance makes them perfect for a multi-lifetime garden. Once these are set up they are permanent, will never wear out in your grandchildren's lifetimes and are easy to maintain.

Of course, naked tires aren't very pretty. They should be painted, especially if you mean to sell them. I suggest grass-green in water-base exterior house paint. You can buy it cheaply in five-gallon containers. A standard tire will take under a cup.

It takes about five minutes to paint one with a four-inch brush, from the top to the bottom of the tread. A cheap spray paint unit will do the job in about a minute, using even less paint.

Start with a basic ten-tire garden plot. Line them up in two rows with each tire separated two inches from its neighbor. Be sure to layer the spaces with wood chips to prevent weeds.

You could fill your own garden with these 60 square foot plots and use

them as standards for your commercial enterprise. These would produce ever so much more than regular gardens.

For instance, one tomato plant, properly supported, fed and watered, would produce over 100 pounds of tomatoes. If you should have 10 such plants, that would be over 1,000 pounds. Sell them for 50 cents a pound and get \$500.00 for some pretty easy part-time work.

Tomatoes aren't seasonal, as most people believe. They die from frost. Keep them warm, feed them well and they'll live for years, producing and producing. A single tomato plant grown in a Japanese greenhouse produced 10,000 pounds.

For tomatoes, cucumbers and Golden or any other small squash, you should use cages. The reason for the cages is that the most productive tomato plants grow up and if not supported will sprawl and the tomatoes will rot on the ground. The cages allow them to grow upward and you just pick the tomatoes throughout the wire. The same goes for cucumbers and small squash.

A good thing about the tires is that they will never disintegrate. So what makes them an environmental nuisance makes them perfect for a multi-lifetime garden.

For the cages, get a 150 foot, five foot high roll of six-inch concrete reinforcing wire from any building supply store. Cut it into four-foot lengths with lineman's pliers. If you don't have strong hands, use a saber-saw with a No.24 metal cutting blade. Hold the wire so it doesn't shimmy and cut flush with the vertical wire. It should zip through the strands one after another. If you don't have electricity you can use a hacksaw with a metal-cutting blade.

Your 150 foot roll will give you 37 cages. I paid \$43.00 tax included, which made each cage cost only \$1.17.

When you get your roll of wire, lay it down so the loose end is on the bottom. Jerk it so you have a few feet to

work with. Count across eight squares and cut flush on the far side of the horizontal strand. Now you have four feet and about two inches of vertical wire facing you.

Take a pair of lineman's pliers and bend one inch of the wire back toward the roll, forming a neat hook. Then bend the whole thing toward the last horizontal strand and connect the hooks all along it. The cage won't be perfectly round and doesn't have to be. But bend it by pressing until it's at least neat.

It might take a few minutes to learn to pull a wire here, push a section there, press the cage somewhere else to get it pretty even and to get the hooks to stay in place up and down the horizontal wire.

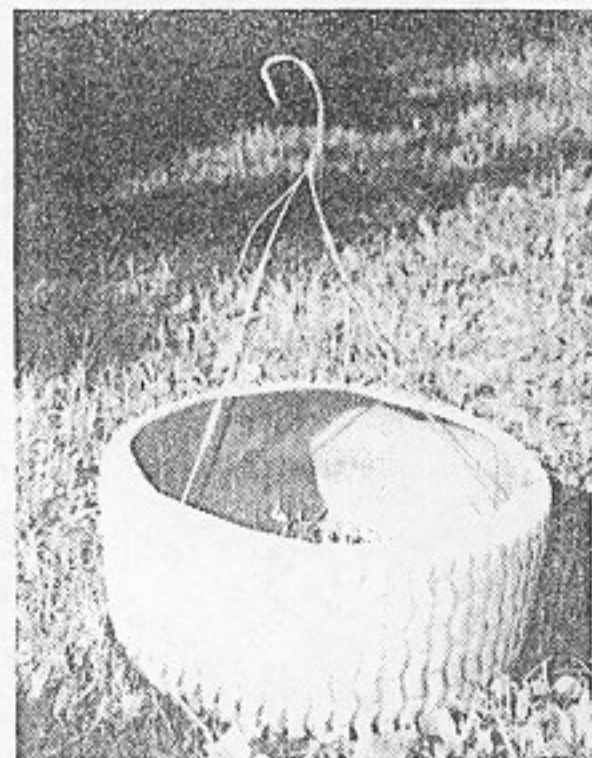
While learning to do this you can practice swearing. Anyway, after about the third cage, you can cut the wire, bend the hooks and make the whole cage in ten minutes or less.

This concrete reinforcing wire is rusty. Concrete doesn't stick well to galvanized wire so I don't think you can get it galvanized and fencing wire isn't as strong. In your own garden you may not care, since there's never enough rust to really soil your hands as you pick. However, it looks better painted. Just cleaning your brush on the outside only takes a little while and covers most of the rust.

You might spray-paint the cages before bending them. After making the hooks, spray-paint the upwardly curved side with the nozzle on the most misty setting. Then put another on top and spray-paint it and so on. When the stack dries there won't be enough rusty spots to notice and certainly not enough to get a customer dirty.

With this raised bed system you can also have a greenhouse for each tire. The tire greenhouse is made of 6 ML greenhouse plastic ordered through any hardware store. An 8 x 100 foot roll costs about \$20.00 and makes 16 greenhouses for the caged tires or 32 for those without cages.

This mini-greenhouse lets you begin your garden two months before the regular growing season. It also lets you keep growing two months after the



Three-wheeler planter

first frost. That way you'll get three garden crops a year instead of two.

To make these mini-greenhouses, first roll out and cut four 6 foot lengths of plastic. Fold each over sideways and close the top and side with 2 inch wide masking tape, neatly so there is one inch on each side. Then run a hot iron slowly down the tape on the top and side, on both sides of the tape, being careful not to get the iron on the bare plastic. This will melt the plastic so there will be a permanent bond.

Take pliers and bend the wires protruding over the tops of the cages inward so they don't poke holes in the plastic.

The greenhouse will fit loosely over the cage and then over the tire. It can be raised as high as needed to get at the bed and for picking and performs all the functions of any greenhouse. It is very stable around the cages since they are put in the tires before the soil is added.

The plastic is guaranteed for two years on a greenhouse. This is for year-round, all weather. These mini-greenhouses would be used only two months each in early spring and late fall. They wouldn't be subjected to the hot summer sun or the winter snow. Just using them when necessary and storing them in winter and summer, they could last up to ten years.

Since 100 feet will make 16 6 foot greenhouses or 32 four footers they are indeed inexpensive. That's only

\$1.25 for the caged tires and .63 cents each for the smaller ones. The smaller ones would be supported by two 2 1/2 foot sticks stuck in the sides of the tires.

So much for the basic tire garden.

Another use for the tires is in making compost. This is simply rotted organic matter such as weeds, garbage, manure and anything else that will break down. Compost is your basic soil conditioner. Gardening magazines show many designs for making composters. They usually involve a lot of wood frames, chicken wire and such and can run into money.

With tires, you can make excellent composters at no cost at all. Simply cut six standard tires at the treads, both sides. Put one down on the bare ground, unless you have a cement or board surface. Fill the first tire, then put on another. Keep filling and stacking until you've used up all your organic matter, and if you have more, ready another set of tires.

After a couple of weeks, lift off the top tire and lay it down beside the stack. Then shovel what was in the top tire into the one on the ground. Repeat with the next and so on. That's all there is to turning compost. In a few weeks, when it all has an earthy smell, it's ready to mix with soil.

Now for the economics of the tire garden.

If it's just for yourself and your family, you can just raise all the veggies you can eat and sell the surplus. Just charge 30% less than the stores and you'll sell all you can raise.

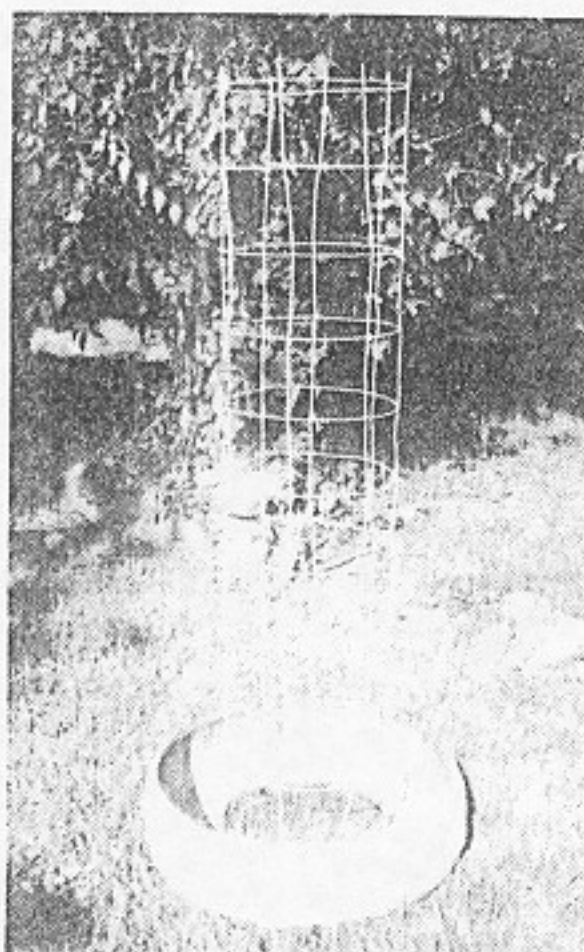
You could supply every restaurant for miles around. Organically grown fresh garden vegetables taste ever so much better than those trucked in from out-of-state. Tomatoes, alone, grown in real soil, locally, have a taste no industrial tomato factory can match. *Organic Gardening* has had several articles about people who make a good living growing nothing but tomatoes.

Say you have a fairly large garden space of 100x100 feet. For an initial investment of a few hundred dollars you could lay out a couple of hundred tires which could compete with any wholesale seller of vegetables.

I'm not going to teach you how to garden. Your library has dozens of good books covering every step of the art. I might suggest, however, that you specialize in just three or four vegetables, get a reputation for quality and freshness and make an excellent living growing and selling them.

But you might rather sell tire gardens themselves. Start with 10 tires, four cages (2 for tomatoes, one for cucumber and one for squash). Throw in four six foot mini-greenhouses and six four footers. Add the planting medium.

The tires cost nothing. The mini-greenhouses cost \$8.58. The cages cost \$4.68. The planting medium (two parts



The concrete reinforcing wire cage

soil to one part compost) may cost up to \$5.00 per tire, or considerably less. Paint, maybe a dollar, and your materials cost is under \$65.00. Of course, there's labor. But if you have a couple of buddies, or make it a family business and sell the 10 tire complete gardens for \$250.00, you'd get about \$185.00 profit or more. Aside from processing, delivery and setup shouldn't take more than a couple of hours.

Marketing tire gardens is easy.

They would sell mainly to older people who couldn't go get the tires, cut them and fill them but would be de-

lighted to plant, care for and harvest them. Most older people would shell out \$250.00 in a minute to insure a large portion of their food for the rest of their lives.

So even if you don't appreciate this idea, older people will. And there will be a market for all the tire gardens you can produce. But there are a lot of mature young people, too. Not all of them are physical enough to gather the materials for the gardens but would welcome them ready-made.

It's no trouble to get soil and compost. Look up "Landscaping" in your Yellow Pages. They'll deliver soil at well under 50 cents a cubic foot, compost and whatever you need, by the truckload. If you just want to set up a tire garden for yourself, your local nursery and garden supply can sell you everything you need at a reasonable cost.

To run such a business, all you need is the simple, cheap and easily available equipment described in this article. You will also need a standard pickup truck, which you may already have. If you don't have one, get one. If you drive a car, trade it in for a pickup. If you're going into any kind of business involving hauling you need a pickup, anyway.

Now to selling the service.

First you set up sample tire gardens, featuring all the ideas in this article and ideas you will come up with. You might even stock a supply of bedding plants, seeds, garden tools, etc., when you've become established. But with your sample gardens, it would be best to have them already started, plants and all. Then contact your local newspaper and they'll be glad to do a feature story.

Put an ad in the same issue saying, "Come and see our tire gardens and let us set up one for you!" People will start coming around and you'll have all the business you can handle from then on.

Don't be afraid others will compete with you. You'll have the jump on any competition if you do a good job, and people will choose you over the competition.

TIRE GARDEN UPDATE BY KURT SAXON

I made a tire garden, as described in my article, "Making And Selling Tire Gardens", issue 2. It was very productive and easy to work.

However, my advice to leave the bottom side of the tire uncut was unwise. It didn't act as a reservoir. I had some of the tires taken up at the end of the season to replace some of the soil I had mixed improperly. I found the bottom rims root-bound.

Also, I had decided to have the tires turned inside-out and this can't be done unless both sides are cut out. Turning the

tires inside-out has five advantages. First is that the deep-rooted plants can go deeper without being stopped by the rim. Second is that the tires gain an inch or more in height. Third is that they are straight instead of rounded, making for slightly more space. Fourth, they save paint, as the treads take up much more paint than the smooth insides. Fifth, if you are selling tire gardens, you can pile them like rubber bands in your pickup, using up less space.

Turning the tires inside-out is easy if you know how. The first step is to step on one side of the tire, pushing it to the ground. Next, reach over and pull the other side of the tire up toward you. Then, keeping your right foot in place, step around with your left foot and put it alongside your right foot from the other side. Now, keeping your left foot on the flattened edge of the tire, push the tire over and grasp the underside of the opposite side and pull. The tire will now be turned inside-out.

If the tires are laid out against a fence or wall, there will be spaces between the curvatures of the tires and the backdrop. Instead of filling these spaces with something to prevent weeds, it is best to fill them with soil, as each space amounts to about a square foot of growing area. These can be planted with a few onions, carrots, beets, etc.

If the backdrop is a wire fence, cardboard or plastic can be put alongside the fence to keep the soil from going through. A ten-tire layout will have four one-foot square spaces between the curvatures. These spaces can also be planted with a pepper plant, an okra plant, an eggplant, etc.

Rather than use pliers to bend the projections from the tops of the reinforced concrete wire cages and the hooks to connect the sides of the cages, I discovered a better tool. It is simply a six inch length of 3/8 inch

TURN a TIRE INSIDE OUT WITH BOTH SIDES CUT OUT

Cut close to the tread on both sides.

The advantages are... You gain about two inches in height, the surface is smoother for painting, & it doesn't look like a tire.



IT'S EASY (Bias or Belt) when you learn the trick.

1 Stomp down one side.



Reach over and pull up opposite side.

2 Stretch tire up.



3

Step around tire & place other foot on opposite side.



4 Push tire over.

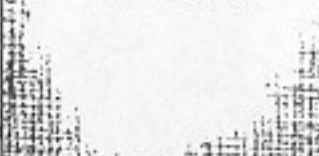


As you stand up, pull up the under side of the far side.

5 The tire is now turned inside out.



This works with any tire that you can stomp one side down on.



outside diameter galvanized pipe from the hardware store. This is perfect. You simply put the pipe over the projection, the length you want, and bend. This is ever so much easier and quicker.

In regards to the plastic mini-greenhouses for caged plants, they are practical. However, ironing their edges is too uncertain in bonding the plastic. A better way is to put the masking tape on as instructed, then with a regular stapler, staple the masking tape and plastic about one inch in and three inches apart. This should hold it together in anything less than a tornado.

Also, you don't need to space the tires two inches apart to accommodate the bottom of the plastic. Just place any sort of weights, such as rocks, around the bottom, resting on the tire rim.

A double use for the concrete reinforcing wire is for a portable cold frame over the tires in early spring and late fall. First bend the wire so it covers both sides of the tops of the tires. Then lay plastic over it and weight it on both sides and the ends. Of course, this is for your shorter plants.

The other use for the wire is for trellises. The concrete reinforcing wire is as sturdy as any trellis material you will need. Just cut the wire as for a cage. Then bend it slightly so it fits along the inside of the tire and fill the tire with soil. Now plant your beans or any climbing vegetable close to the wire and you have got the best trellis ever.

Be sure to order the tire recycling book. It will give you many more ideas for using tires both around your place and to make a good, low-overhead living.

5 3/4 X 6 1/2 105 PAGES \$15.00

Tire Recycling is Fun. Instant business, low overhead, start now! Go to your tire store. As they install tires, the old ones are piled in back, free for the taking. Use a saber saw and a blade ground on both sides so it cuts and saws. (Sample blade included). After drilling a quarter-inch hole by the tread, saw away. Make raised beds for gardening. Make a tire horse swing you can mount on a 2x4 frame for demonstration at flea markets, swap meets, etc. Takes about an hour and a half to make one. A few nuts and bolts and a little paint for pretty will sell a dozen over a weekend at \$25.00 each.

Taping Leaks in Garden Hose

TO TAPE a leak in a garden hose, first apply electrician's rubber tape, stretching it well. Cover this with a layer or more of black friction tape. Should the friction tape loosen, it can be replaced without disturbing the original repair.—W. H. QUADE.

PEANUT BRITTLE

1 lb. sugar; 1 quart peanuts.

Shell the peanuts, remove the skins, and chop the meats fine. Sprinkle them with one-fourth teaspoon of salt. Put the sugar in an iron frying pan, place it on the range, and stir the sugar constantly until it melts to a sirup, taking care to keep it away from the sides of the pan. Add the nut meats, pour the mixture at once into a warm buttered tin, and mark it in small squares. If the sugar is not removed from the range as soon as it is melted, it will quickly scorch. A wooden potato masher dipped in water may be used to smooth the mixture when it has been turned into the tin.



HOW TO MARKET YOUR PRODUCTS BY KURT SAXON

Before you worry about marketing, you must first assure yourself of a steady, dependable supply of your product. You must guarantee delivery of the quantity and quality of your product or you will lose clients. Otherwise you will be confined to garage sales, flea markets and swap meets.

Before you are able to mass-produce, you might consider flea markets. Actually, weekend flea-markets are a good test for your products. They are cheap to set up at and attract a cross-section of society. Also, in talking with fellow dealers, you will learn a lot about marketing on a shoestring.

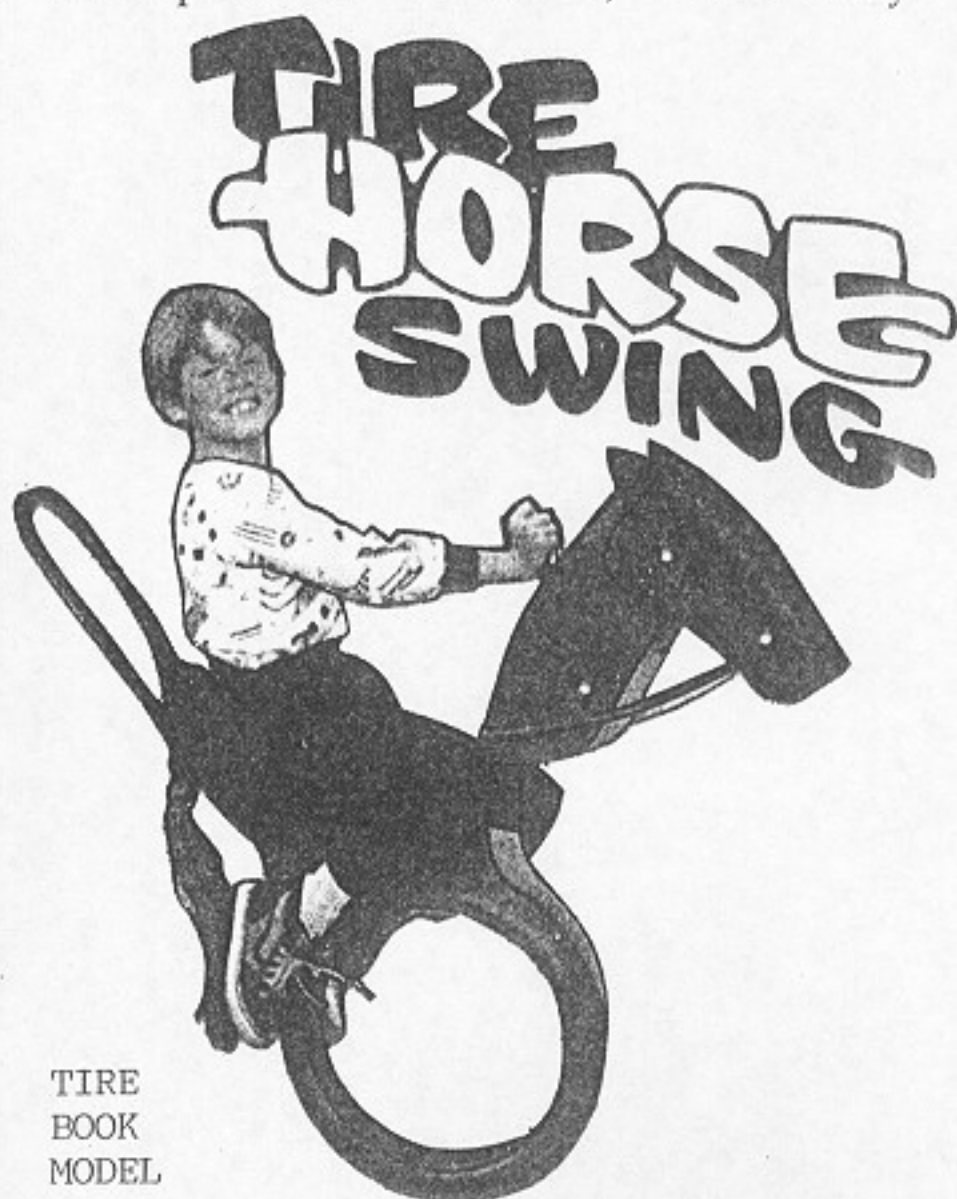
A good start at both manufacturing and marketing is the tire-horse swing. This is an idea which could start anyone on a good part-time business with practically no overhead. All you need is a saber saw, drill, a few nuts and bolts, some cans of brightly colored paint and some used, but not badly

worn, tires.

Any shop selling and installing tires has a stack of replaced tires, free for the taking. What you should look for are non-steel belt, 13, 14, 15 or 16 inch, four ply or less, evenly rounded on the edges, no threads showing. Once you learn to pick out the right size tires you will have no trouble getting all you want.

After you have made a couple of tire-horse swings you will be able to turn out one in about two hours, including painting. Then mount one on a two-by-four frame and take it to a flea market. Whenever a small child comes near, invite him to try it out. You will then get a quick sale from the parents.

I would suggest a price of about \$30.00, but one company is offering them for \$65.00! Of course, that company has to buy them from people like you. Charge what you



TIRE
BOOK
MODEL



Old Time Recycled Tire Swing

The swing you've always wanted for your children. Hitch it to a tree, hang it from a covered porch, or add it to a swing set. This classic recycled tire swing from Texas is guaranteed to bring hours of galloping joy. With a rope fringe mane and tail and colorful neck bandanna, this bronco comes ready to buck it up in the backyard. The rodeo swing holds up to 200 pounds and is recommended for children age 2 to 12. Covered hardware ensures a smooth, safe ride. Happy trails!

■ 90-645 Rodeo Tire Swing \$65

think they will bring but even at \$30.00 you would be doing fine. Also, the more reasonable your price, the more you will sell.

There are two basic considerations in marketing. The first is, who needs what you have to sell? If you are filling a need, targeting is easy. The grocery, hardware store, etc.

The second consideration comes into play when your product is something people can do without. That takes salesmanship. You have to make people believe they really need what they only might want.

In case you are not experienced at this, you need to talk to someone who makes a living at it. Your best bet is to take your ideas to a local newspaper and discuss it with the advertising manager. Since newspapers sell advertising, the manager will size up your product and advise you on the best way to promote it.

Naturally, the idea would be to sell you ad space. But even so, if you get help in working out a successful ad, it's worth it. If the ad flops, they lose your business, so there is a good chance they will do well by you.

You will get the best efforts from a local newspaper. Also, if you don't have a large output, a paper with a huge circulation might give you more business that you can handle. If you are prepared to expand, that's fine. But if you plan to confine your production to your home, with a custom line, you might find that too much business is a curse.

Most people think first of classifieds. They are usually cheap, especially in local newspapers. But unless you have a product much in demand and easily classified, you are wasting your money.

Few people read the classifieds unless they are looking for something they want. I once paid over \$400.00 for a lengthy classified in *The National Enquirer*, circulation four million, for my food book. I got three orders. I hadn't analyzed the readership. *Enquirer*

readers are mostly fantasizers. They aren't looking for books on self-sufficiency.

Another thing about classifieds in national publications is that subscribers, the bulk of the readership, gets bored with the publication after a few issues. After the subscriber leafs through each issue, he dumps it without paying attention even to the display ads, much less the classifieds.

If you are a craftsman, you may market your wares through gift shops. Few gift shops pay up front for homemade crafts.. Instead, they work on consignment. If they sell your items you get paid, less their percentage.

If they only sell on consignment, you may do well having them market your goods. But if they also sell many items they have to pay up front for, go elsewhere. What will happen is that the items they have had to pay for will be promoted and displayed prominently. This way they are getting their investment back.

Meanwhile, your items stay at the back of the shop. If a browser really has to have it, there's a sale. Otherwise, you have farmed out a lot of dust collectors.

Again, let your newspaper ad man advise you. You might be able to market through his paper. Besides, he may even know area shops which would do better by you if advertising on your own weren't practical. His advice is free and usually good.

You might also consider direct marketing by renting a store or even selling various items at a vegetable stand, as described in issue 2. Everyone should have a garden. If you do have a large garden space, plan to grow a surplus to sell. Put up a stand by the side of the road or even in your front yard.

Then there is always the flea market. You might even set up your own flea market, which is just an overgrown garage sale. Regardless, you can sell anything you produce if it is of good quality and if you are set up to turn it out in volume.

PORTABLE ROAD-SIDE STAND

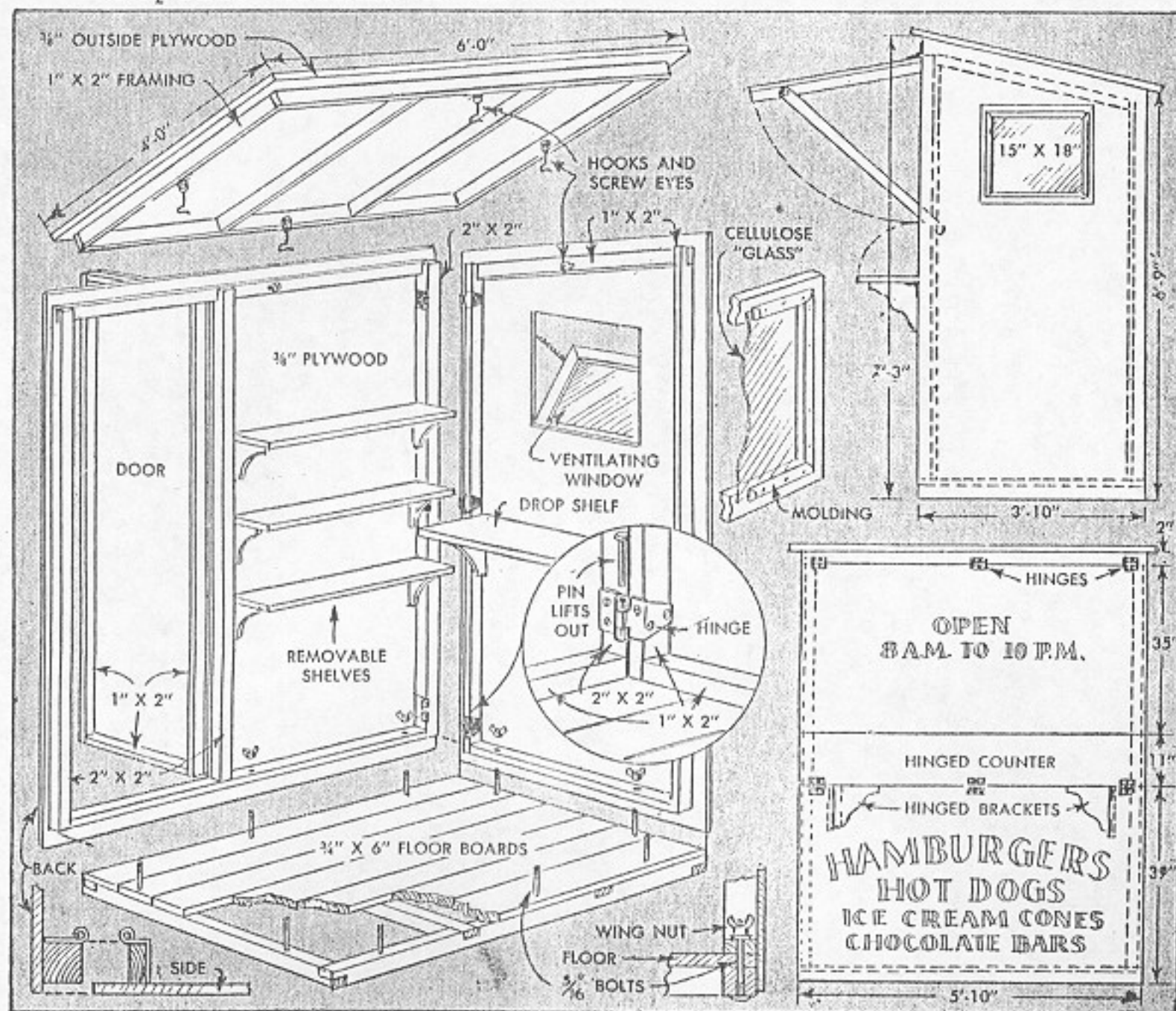
For the Business Go-Getter



Also Vegetable Stand

Because of the unusual wing-nut-and-hinge-pin "joinery" it takes one man only a few minutes to set up this roadside stand where the business is best. The whole affair consists of six waterproof plywood panels which make the top, ends, back and divided front. Tongued-and-grooved boards nailed to a 2 by 2-in. frame make the floor. At closing time the hinged counter swings up and the canopy comes down, closing the stand weather-tight. Exit is through a door at the back.

Popular Mechanics 1948

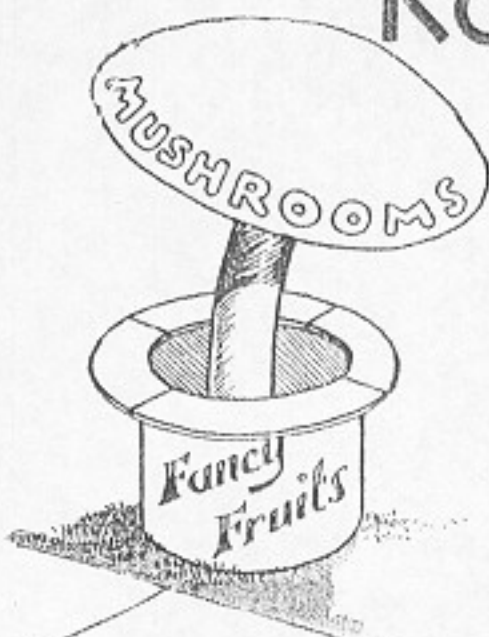


Roadside Booths Attract Trade

POPULAR HOMECRAFT JULY-AUGUST, 1938

HI SIBLEY

The novelty of a roadside booth attracts motorists to stop. We present several ideas to augment your income.



THE manner in which an article is displayed has much to do with its sale, and here are presented a few roadside booths which by their very novelty are sure to attract the passing motorist.

Fig. 1 is a fruit and vegetable stand of very simple construction, but which displays garden produce in a clean and inviting manner. The framing is of common lumber and a bright awning lends a touch of color—preferably red or orange to contrast with the green goods on sale.

In locating any roadside stand, bear in mind that it should be easily accessible to the motorist, with room enough to draw out of the way of traffic, and at the same time visible from a distance down the road.

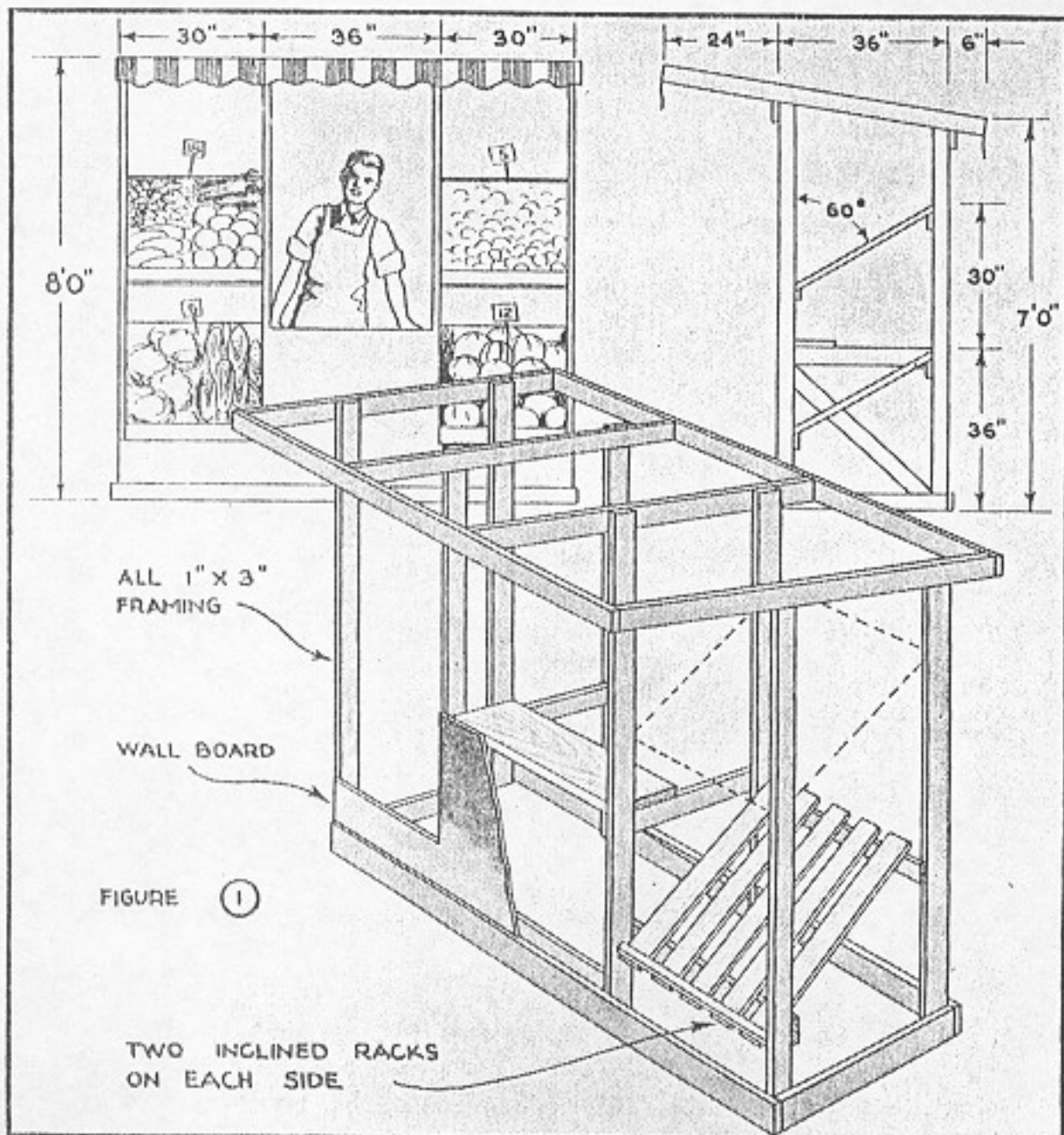
"The Cookie Crock"

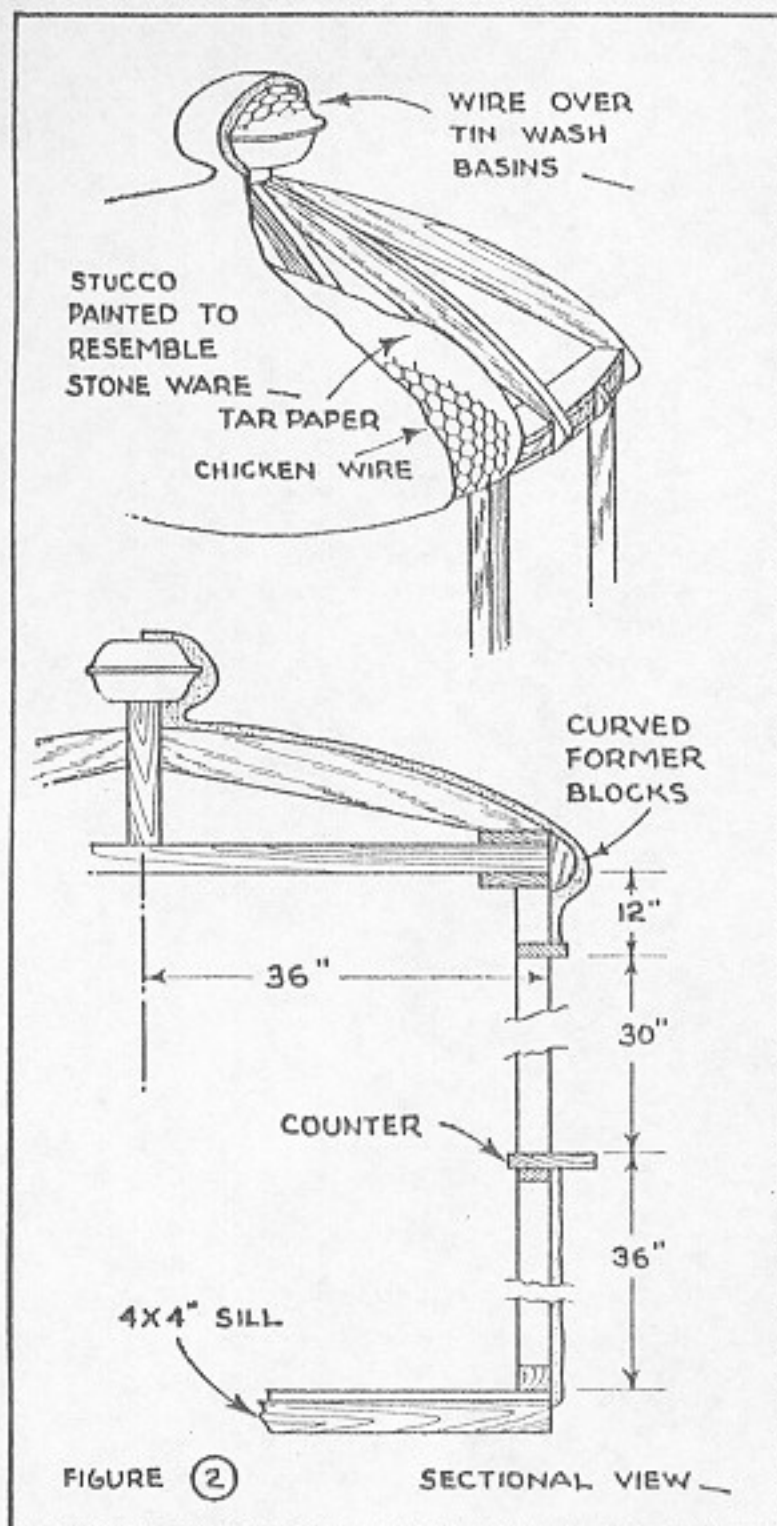
For baked goods, pies, cakes, etc., the "Old Cookie Crock" is appropriate. This cylindrical little structure is simply a rough wood frame covered with tar paper and chicken wire, and plastered over. Curved rafters and small semi-circular former blocks give the roof its shape, and the knob is built up of two tin wash-basins concealed in stucco. Provision for a door is made in back, and shelves are arranged inside for stocking goods. Paint the stucco to resemble stone-ware, with the lettering in a light blue. Fig. 2.

A mushroom shelter with circular counter is not as complicated in

construction as might appear at first glance. The inclined stalk is built up on a 3" iron pipe with a slight bend in the middle. Curved former blocks are fastened on with bolts at 12" inter-

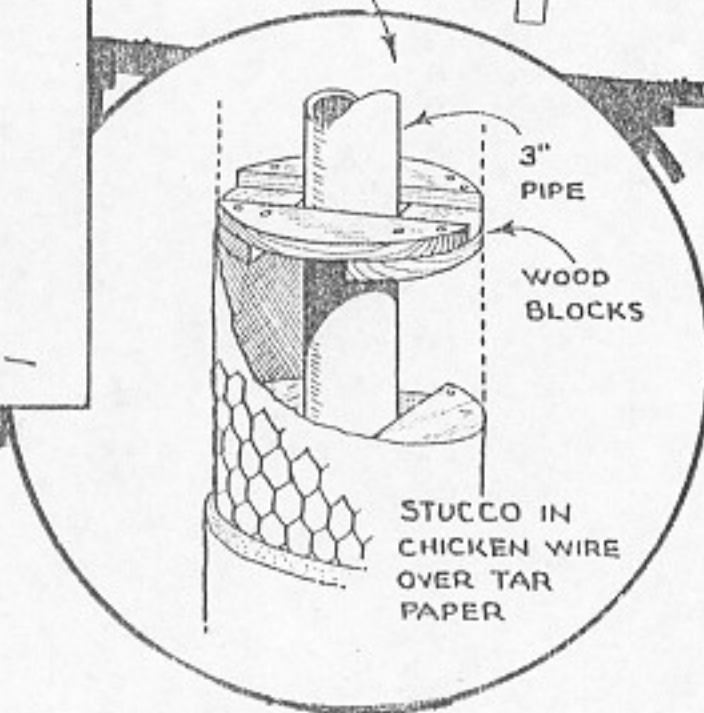
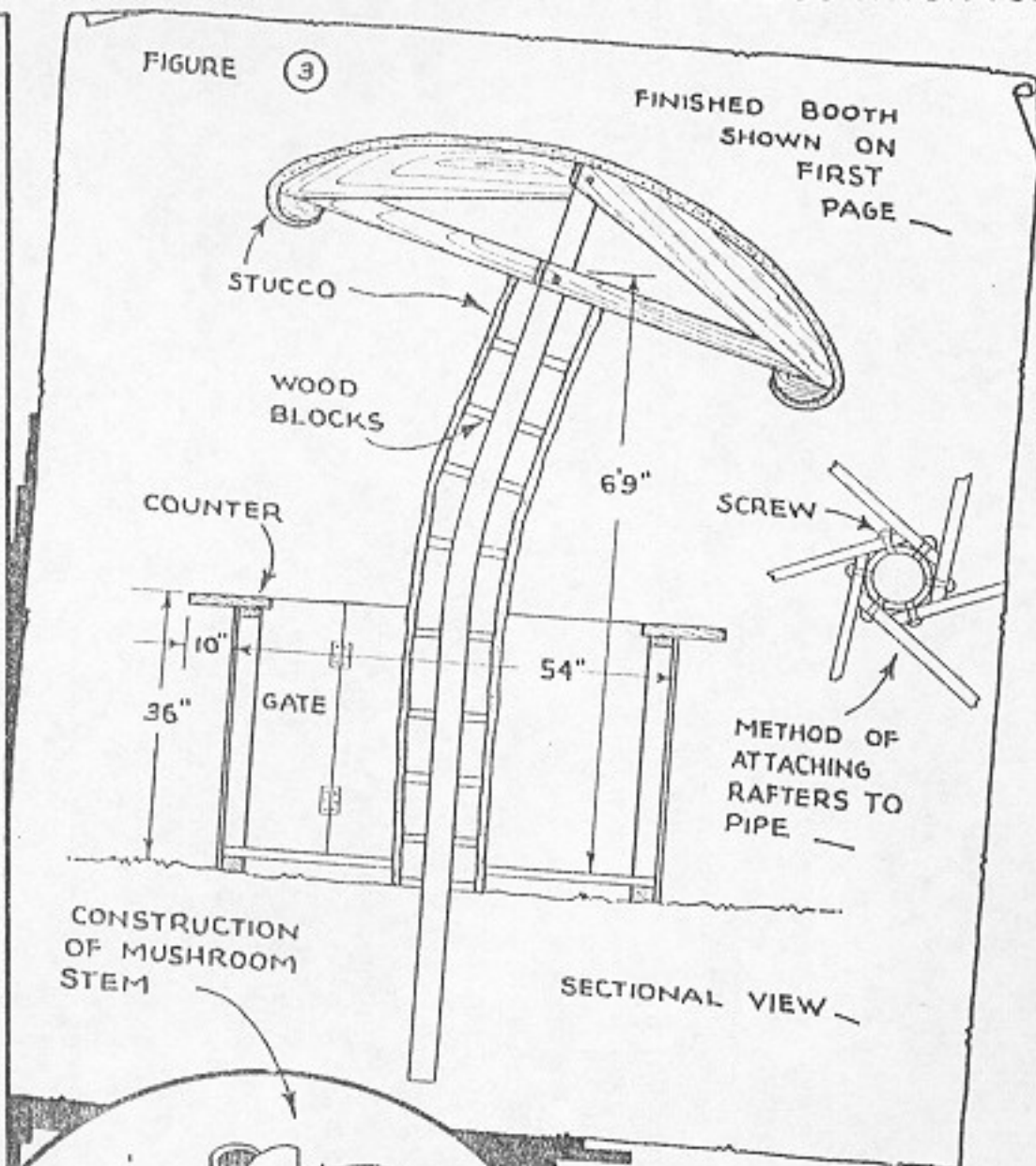
vals and covered with tar paper and chicken wire, and plastered over with smooth white stucco. The roof is built similar to that of the cookie jar. Plywood is used for the circular





counter, and sheathed below with $\frac{1}{8}$ " hard pressed board (Masonite). Green lettering is effective for this booth. Fig. 3.

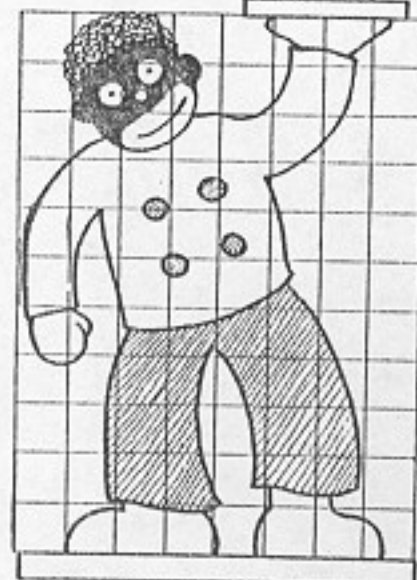
A group of little colored boys holding up potted plants at the roadside—or any other product—will have instant appeal. These are scroll-sawed from half-inch plywood to the pattern in Fig. 4. Paint them in bright colors and mount on a substantial wooden base.



POTTED PLANT
OR OTHER PRO-
DUCT FOR SALE

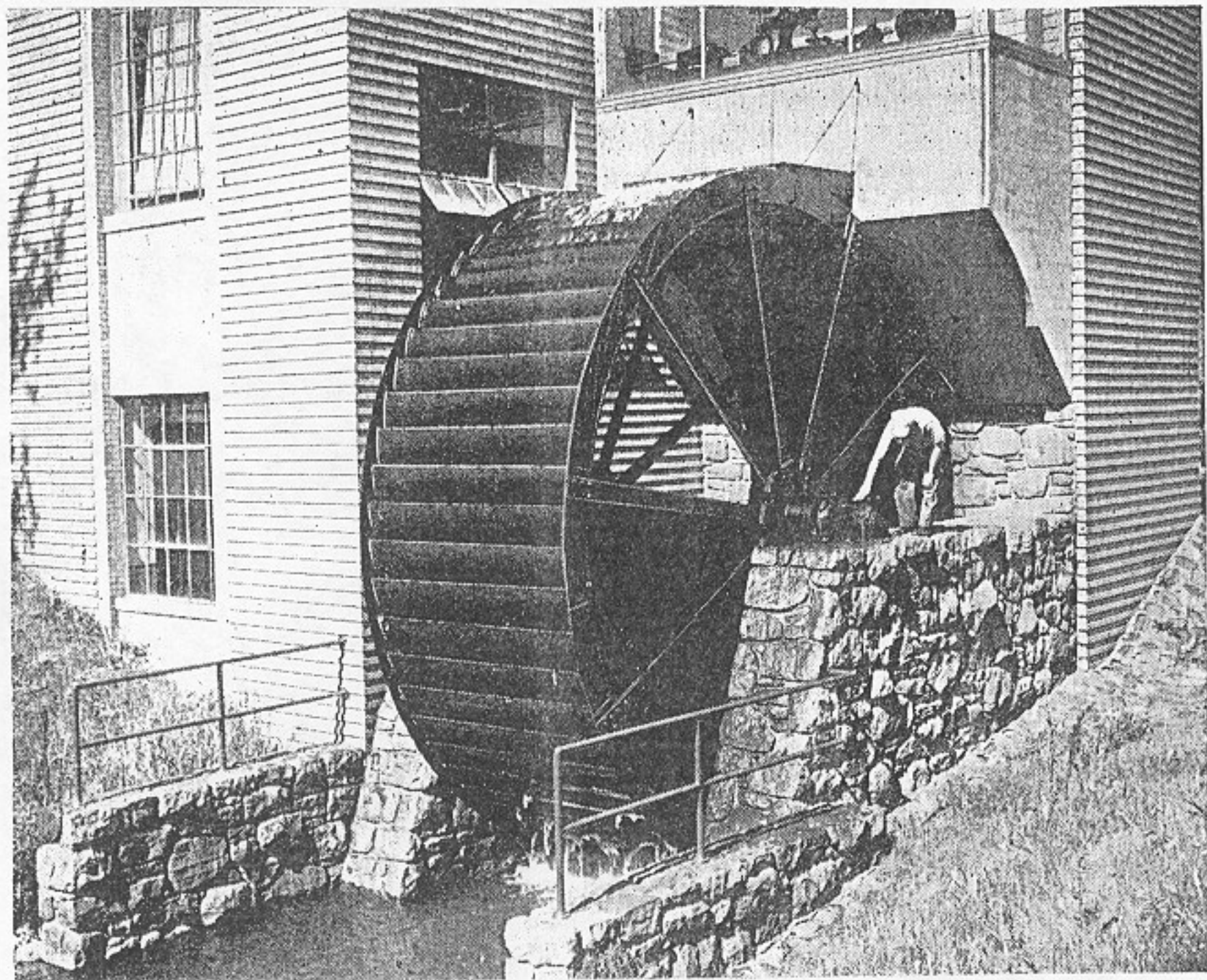
FIGURE 4

FIGURE SCROLL-
SAWED FROM $\frac{3}{4}$ "
PLYWOOD AND
BRIGHTLY PAINTED



2" SQUARES

WELL-KEPT TOOLS MEAN
WELL-DONE WORK



Gravity turns the overshot wheel. Water-carrying buckets on one side overbalance the empty ones opposite.

Building an Overshot Wheel

POPULAR SCIENCE AUGUST 1947

Besides furnishing power, it brings an old-time air to its surroundings. Here are plans for a 5' wheel.

By C. D. Bassett

OFTEN seen beside a picturesque rural mill, an overshot water wheel possesses two excellent characteristics—considerable mechanical efficiency and easy maintenance. Many have remained in service for decades, and now lend a nostalgic charm to their surroundings.

Operated by gravity, the overshot wheel derives its name from the manner in which water enters the buckets set around its

periphery. Pouring from a flume above the wheel, the water shoots into buckets on the down-moving side, overbalancing the empty ones opposite and keeping the wheel in slow rotation.

Since such a wheel may be located near but not actually in the stream, it offers endless landscaping possibilities for a country home where a stream with sufficient flow is available. If a site on dry ground is chosen, the foundation may be constructed dry and the water led to the wheel and a tailrace excavated. With very little effort, the scene may be turned into an attractive garden spot, the wheel becoming both a landscaping feature and a source of power.

It should be noted, however, that an overshot wheel is practical only for a small-capacity output. How much power it will

produce depends upon the weight of water the buckets hold and its radius, or lever arm. Expressed in another way, the output depends upon the weight of water transported and the height, or head, through which it falls while in the buckets. For maximum efficiency, the wheel must use the weight of the water through as much of the head as possible. Therefore, the buckets should not spill or sling water until very near tail water.

Power Increases with Width

Although of simple construction, an over-shot wheel is cumbersome in size. For this reason, before attempting to build one be certain you have the facilities to move and lift it into place when completed. Also allow yourself plenty of working floor space. It must be understood, too, that such a wheel is a sizable project and requires a lot of material and time. Extreme care in cutting and assembling the parts is not essential, however, because the wheel, operating at slow speed, need not be accurately balanced.

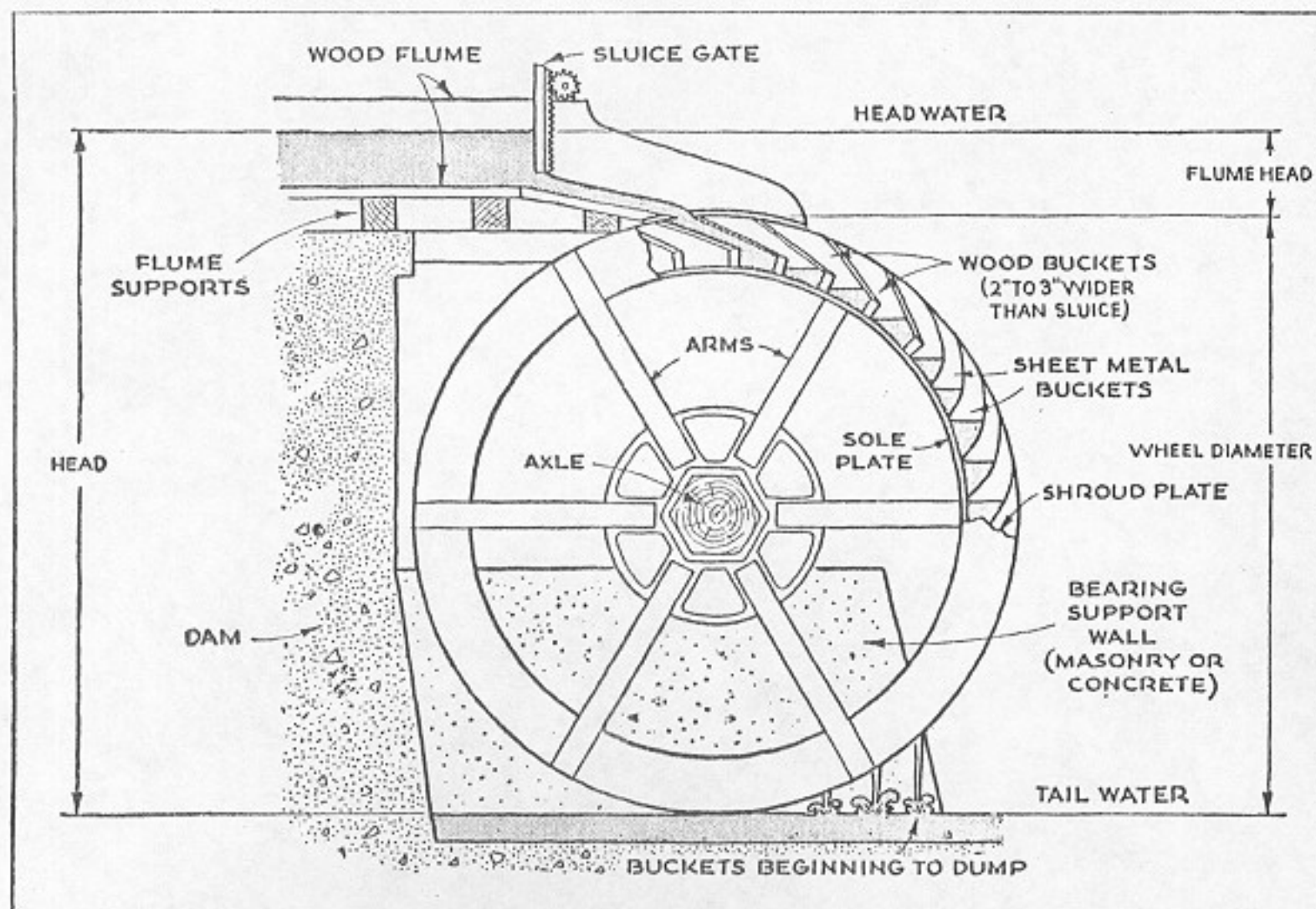
Accompanying this article are drawings that illustrate the construction of a small wheel suitable for a water head of 6' 3". The wheel itself has a diameter of 5', leaving a flume head of 15" to propel the water

into the buckets. As shown in the table at the bottom of page 195, you may build the wheel to give a power output ranging from $\frac{1}{2}$ hp. to 1 hp. at 10 r.p.m. All dimensions remain the same except the width, the horsepower increasing as this is increased. For $\frac{1}{2}$ hp., the wheel should be 15 $\frac{31}{32}$ " wide. For 1 hp., it should be 31 $\frac{29}{32}$ ". Before deciding on the wheel size, you'll want to make a survey of the power available in the stream (PSM, April and May '47).

Virtually all large wheels are built with wood or steel arms, as in the drawing below, and have a shroud plate only around the outer edge, but you may find it simpler and more satisfactory to build the drum-type wheel described here. In this case, each shroud plate is a disk of $\frac{1}{8}$ " sheet steel. Each disk is braced by a $\frac{1}{8}$ " sheet steel sole plate to which it is continuously welded, by the buckets, by one of the two large diameter $\frac{1}{4}$ " steel hub flanges to which it also is continuously welded, and by the long hub itself.

Large Sheet Required

If preferred, the shroud plates may be made of wood. If so, care should be taken to bolt them securely to the hub flanges. Bushings pressed into the wood for the bolts



For highest efficiency, the buckets must carry their load almost to tail water before beginning to spill.

will give the wheel a longer life expectancy.

Sheet steel for the disks may be ordered direct from several large steel companies in case your local supply house is unable to furnish it. Ordinarily, such steel comes in standard 48" widths, so you may have to weld together two or more sheets to get the required 5' diameter, using either a butt weld or a backing plate. This will produce some distortion or ripple, as will the welding on of the numerous clips required. So long as distortion is local, however, and the main lines of wheel and shaft remain true, this will do no harm.

After the sheet has been prepared, scribe a 5' circle on it and cut it with the cutting flame of a gas welding torch. With ordinary care, this method should give sufficient accuracy. Vent and drainage holes should be drilled as indicated around each disk to lessen corrosion within the drum.

Good Buckets Important

The buckets are the most important element of the wheel. To give maximum efficiency, they must be formed so that the water enters smoothly at the top of their travel and remains in them until just before they reach the bottom. For this reason, the bucket form indicated on the facing page should be followed faithfully. Either sheet metal or wood is an acceptable material, but metal is better suited to cold climates, since wood is damaged when absorbed water freezes. Because the buckets are subject to wear from the water and sediment that it carries along, you may want to install them so they can be easily replaced.

In laying out and making wooden buckets, follow these steps:

Using a common center, strike off two arcs, one with a 21½" radius and the other with a 2' 6" radius. Then draw a radius line intersecting these arcs.

From the point where the radius crosses the inner arc, measure 2¾" farther along the line and mark the point *E*.

From the point where the radius crosses the outer arc, draw a chord 10½" long and from the new point where this intersects the outer arc draw a line to point *E*. You now have the inner trace of the bucket.

Take a piece of the bucket stock and lay it along the upper edge of this inner trace and draw a line representing the thickness of the stock. Repeat this along the outer edge of the inner trace, and you have a cross section through the bucket. Cut your stock

accordingly, making the length equal to *B* in the table of dimensions.

Steel Buckets Require Jig

Steel buckets are only slightly more difficult if you follow these steps:

Using a common center, strike off two arcs on a piece of plywood, one with a 21½" radius and the other with a 2' 6" radius.

Draw a radius line and then a tangent to the inner arc, making it vertical to the radius. From the point of tangency, measure 5" along the tangent. Mark this point.

Using this mark as a center, strike off an arc with a 5" radius. This is part of the inner trace of the bucket.

At the point where the original radius line (Step 2) crosses the outer arc, draw a chord 10½" long, and at point *F* where this chord intersects the outer arc draw a new radius line. Also at point *F* measure off 15 deg. below the new radius and draw line *FG* 11½" long.

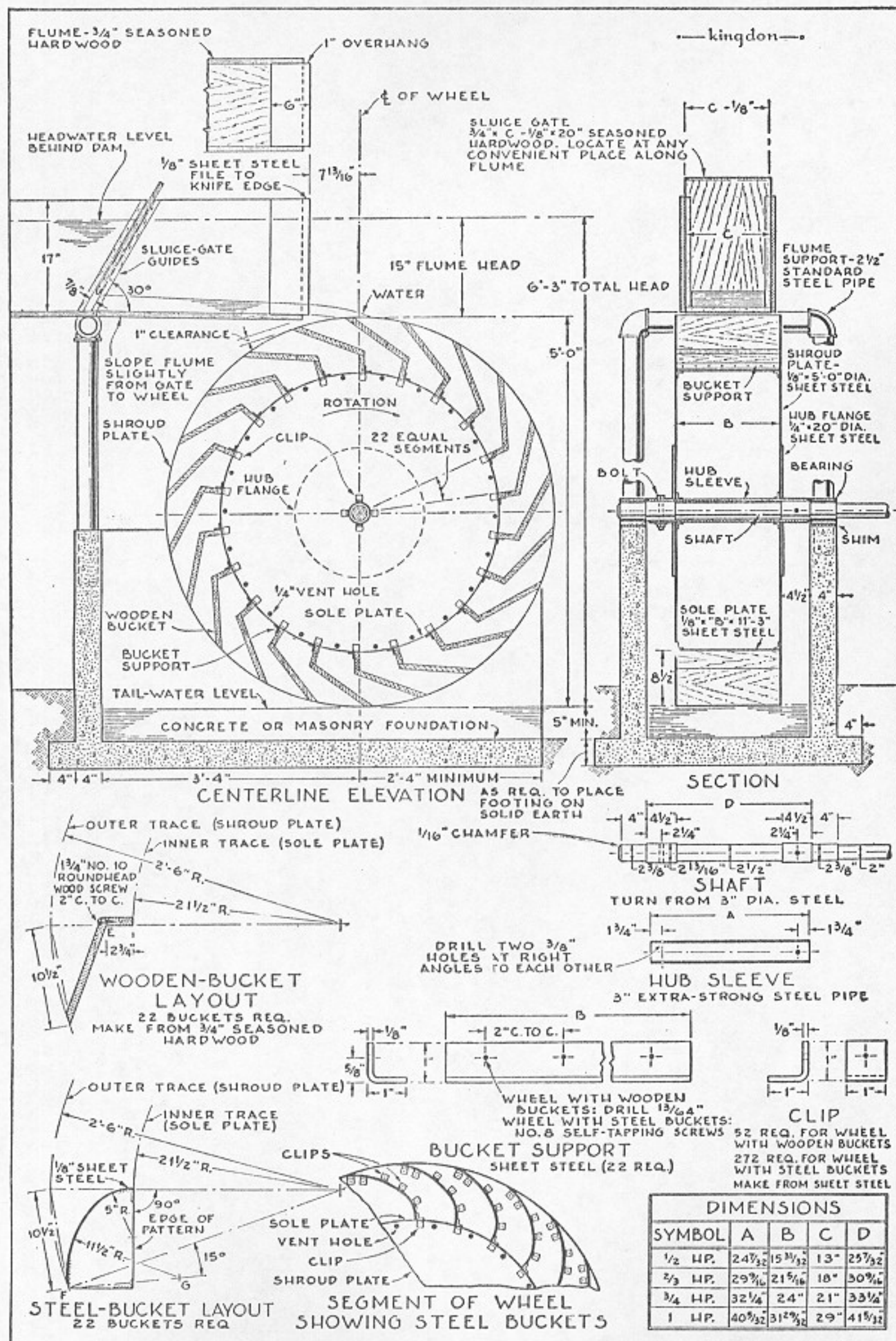
Then, using *G* as a center, strike an arc with a 11½" radius. This forms the rest of the inner trace of the bucket.

Cut the plywood along this line and along the lines that form a quarter ellipse. Using this as a pattern, cut several more quarter ellipses from scrap. Nail these to stretchers to make a bending jig around which the buckets may be formed.

Weld Wheel Parts

Welding of the various parts of the wheel produces an exceptionally strong construction. After getting together or making all the required parts, begin the assembly by welding four clips to each end of the hub sleeve. Then weld the required number of clips to the shroud plates for the sole plate, and weld the shroud plates to the clips on the hub sleeve. After welding both hub flanges to the shroud plates and the sleeve with a continuous weld, attach the sole plate to the clips on the shroud plates with No. 8 self-tapping screws. Also weld the sole plate to the shroud plates with a continuous weld, and the bucket-support angles to the sole plate.

Attach wooden buckets to the supports with ¾" No. 10 roundhead wood screws, and then drill holes 2" from center to center through the shroud plates for 1¾" No. 10 roundhead wood screws. If you use steel buckets, rivet or screw 10 clips to each side of each bucket and attach the buckets to the angles with No. 8 self-tapping screws. Then



Increasing the width of the wheel will boost its horsepower output. All other dimensions remain the same.

drill holes through the shroud plates in the way of the clips for the same type of screws.

Lubricate Bearings Well

Using locknuts and washers, fasten the hub sleeve to the shaft with two $\frac{3}{8}$ " by $4\frac{1}{2}$ " bolts, placed at right angles to each other. Two bearing mountings having $2\frac{3}{4}$ " renewable liners with shoulders should be bolted to the foundation. Place shims about $\frac{1}{8}$ " thick under the bearings.

Standard bearing mountings, variously called pedestals or blocks, may be bought complete with wick oiler or cup oil reservoir and with built-in self-aligning features. Standard bronze bearing metal liners or inserts likewise may be bought from any machine component supplier. Babbitt liners are equally satisfactory.

Although the wheel turns slowly, it is heavy and will be running almost constantly, so good lubrication of the bearings is essential. To this end, care should be taken to insure that the bearing liners are finished to the correct fit. Porous inserts or inserts containing graphite are excellent for this application, but may cost more than regular bearing inserts.

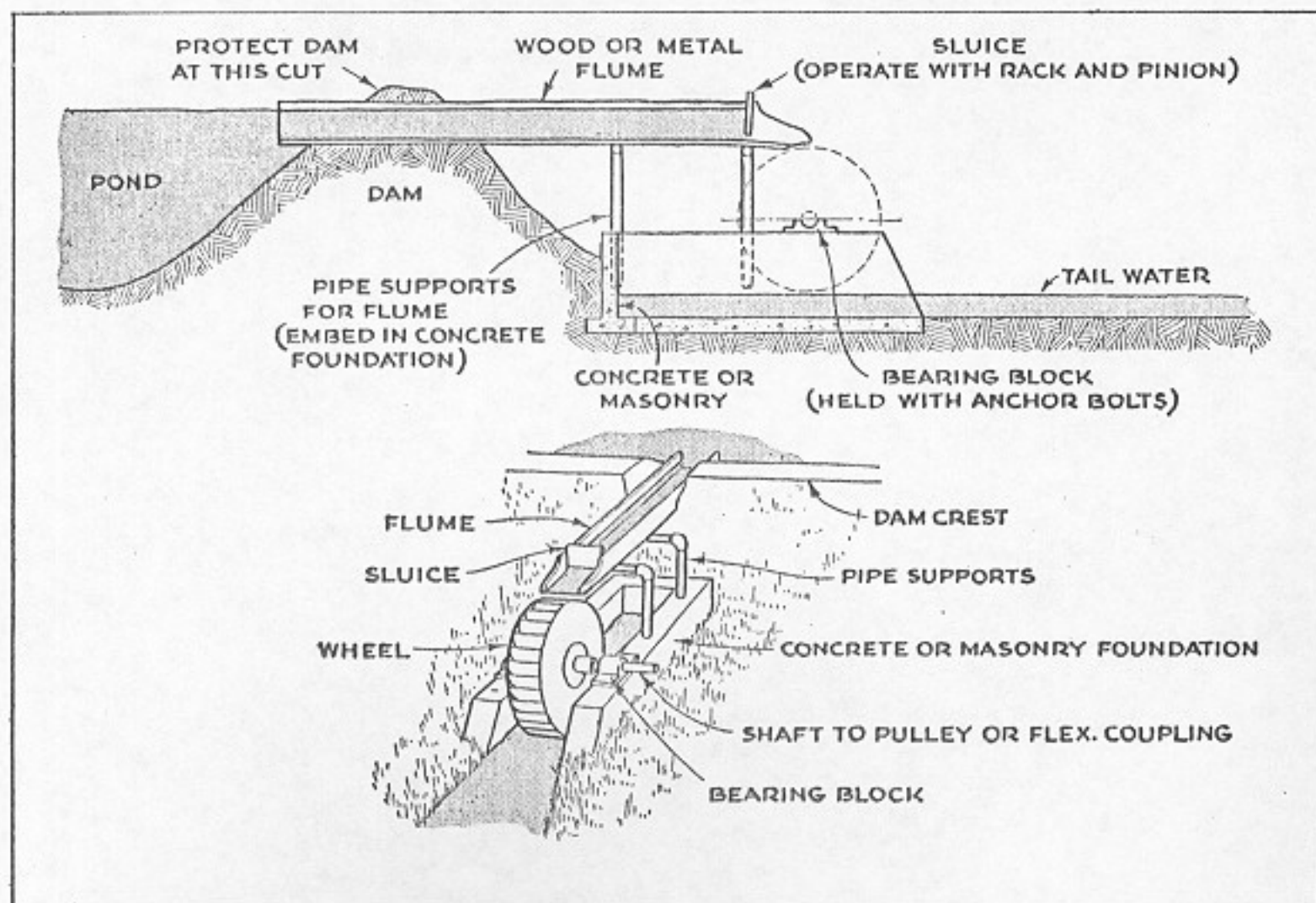
It is important that the foundation be carried deep enough so that water falling from

the buckets will not undermine it. Avoid a long flume if possible, in order to keep the construction as simple as possible. Strengthen it along its entire length with an exterior frame and support it well from dam to wheel with pipe uprights.

Sluice Governs Wheel

The sluice gate may be located at any convenient place along the flume. Since it is the governing mechanism of the wheel, its installation should be anything but slipshod. If it is installed at an angle as on page 195, water pressure will keep it at any desired position. If installed vertically, some mechanism, such as a rack and pinion, should be provided to keep it in place.

Adjust the sluice so that the buckets will run one-quarter full. This will give a wheel speed of 10 r.p.m. If the buckets are allowed to run more than one-quarter full, the efficiency of the wheel will drop for two reasons. Because of the increased speed, centrifugal force will throw water from the buckets. They also will begin to spill before approaching tail water. Although this practice does waste water, it may be profitably employed during a freshet to increase the power output, for at such times the excess water would be wasted anyway. END



As the headwater rises or falls, the sluice gate may be adjusted to meter the correct flow to the wheel.

HALF *an* ACRE and

POPULAR MECHANICS 1935

By H. W. MAGEE

WOULD you like to own a home?

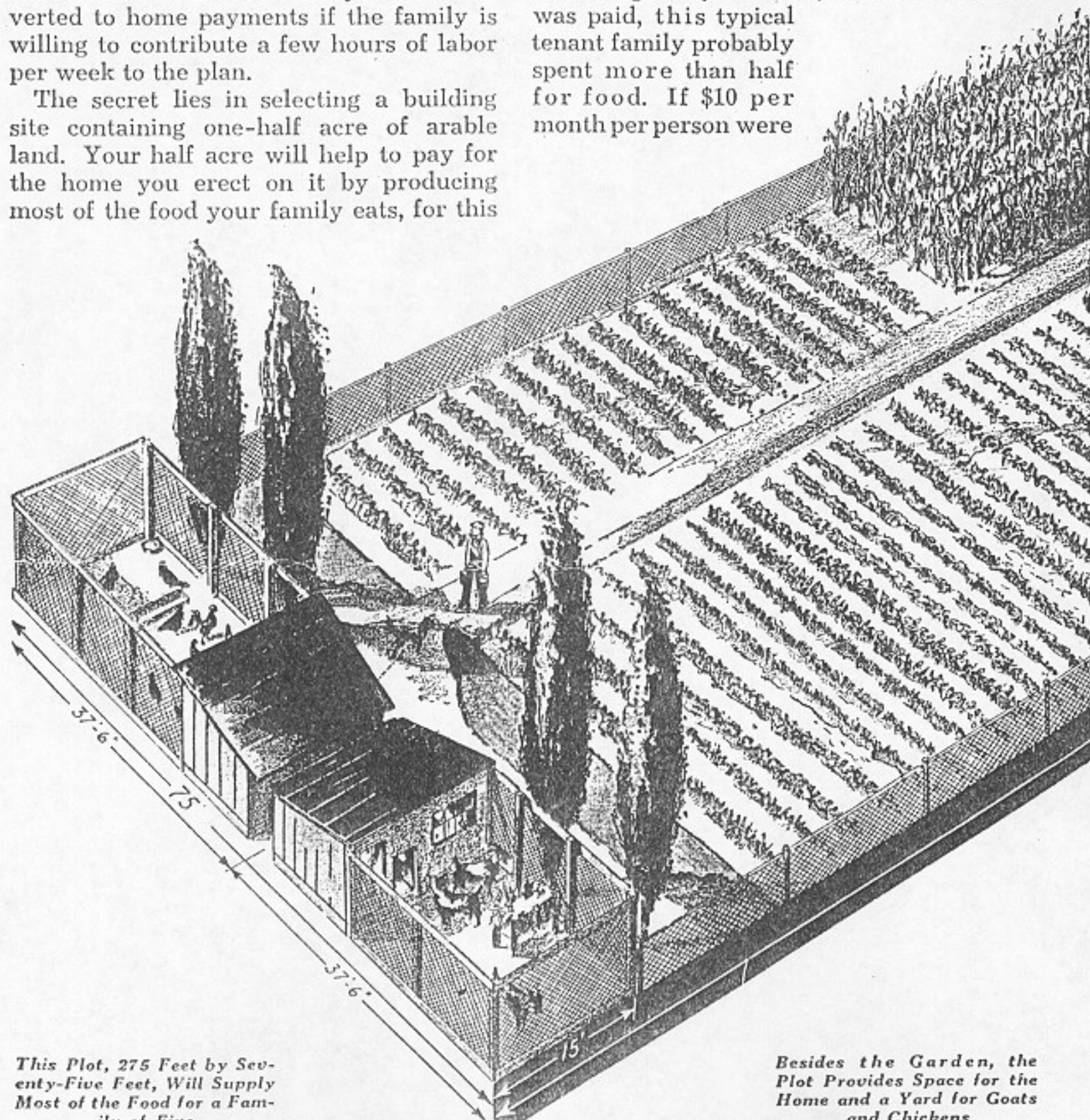
Why not buy it and let your grocer and landlord pay for it?

Thousands of urban tenant families have this opportunity. Most such families pay enough for food and rent in a few years to purchase a home. All the rent money and much of the food money can be diverted to home payments if the family is willing to contribute a few hours of labor per week to the plan.

The secret lies in selecting a building site containing one-half acre of arable land. Your half acre will help to pay for the home you erect on it by producing most of the food your family eats, for this

amount of ground will almost support five persons. It is surprising how much food can be grown on a few hundred square feet of good soil.

The average urban tenant family in 1933 had an annual income of \$1,062 of which \$252 went for rent, according to a department of commerce survey covering sixty-one cities. These figures probably are not far wrong today. Of the \$810 left after rent was paid, this typical tenant family probably spent more than half for food. If \$10 per month per person were



This Plot, 275 Feet by Seventy-Five Feet, Will Supply Most of the Food for a Family of Five

Besides the Garden, the Plot Provides Space for the Home and a Yard for Goats and Chickens



Independence

allowed for food, for instance, the grocery, meat and milk bill for a family of five would total \$600 per year.

Here's what the same family can do in the way of feeding itself from half an acre. The Illinois Emergency Relief Commission last year provided garden plots containing 5,000 square feet each to many needy families, and in one section of 45.9 acres, 341 families raised 417,658 pounds of vegetables, an average production per plot of 1,420 pounds. Each family averaged about one-half hour of garden work daily for five months.

This provides a yardstick to measure the food your half acre will produce and the amount of time you must spend in your

garden to produce it. A liberal diet requires 752 pounds of vegetables per person per year, according to government figures,

or 3,760 pounds of vegetables for a family of five. On the basis of the average production of the 341 families, about 13,650 square feet of soil should grow all the vegetables an average family needs. Let's add ten per cent for good measure, and make it 15,015 square feet.

The same figures indicate that you need average less than an hour and one-half per day in your garden for the five growing and harvesting months to produce nearly two tons of food.

But that is not all. The government estimates that 305 quarts of milk per person per year are needed in a liberal diet, or 1,525 quarts for a family of five. Two milk goats, living partly on vegetable tops from your garden and scraps from your table, will supply all your milk. The government also figures thirty dozen eggs per year are required in a liberal diet for one person. A flock of twenty-five laying hens, a dozen other hens and a score of young chickens will furnish all the eggs needed for five persons, plus about 125 pounds of meat

per year—a chicken for every Sunday.

You will need a yard about fifteen by thirty-seven and one-half feet for your goats and a yard of similar dimensions for the chickens, a total of 1,125 square feet. Suppose you provide an area seventy-five by fifty-seven feet for your house and yard, or 4,275 square feet. This makes a total of 20,415 square feet, less than half an acre, in a plot seventy-five by 275 feet.

Feed for your goats and chickens, in addition to vegetable tops and table scraps, will cost you about \$65 per year. Preparing and planting the garden will probably cost \$15, plus nine dollars for supervision.

The yearly food requirements remaining to be purchased for a liberal diet, according to government figures, are 100 pounds of flour and cereals per person, sixty pounds of sugar per person and 165 pounds of meat, poultry and fish per person, from which is subtracted the 125 pounds of meat from the chicken yard. Suppose flour averages four cents per pound, sugar five and one-quarter cents, and meat, poultry and fish sixteen cents.

Then your total yearly outlay for retail purchased food, aside from occasional incidentals, is \$147.75 for a family of five. Add to this the feed purchased for your goats and chickens and the cost of supervising and planting the garden, and the total is \$236.75, or \$47.35 per person per year—less than a dollar a week per person for food. If you include the original cost of the two goats and the chickens—about \$100—your total for the year is \$336.75.

Let's be liberal and allow a whole dollar per day for food for five—\$365 per year. What about the cost of your half acre? Prices vary with location. Since you live in a city now, you probably are employed in a city, so you must select a half acre near transportation to your work. That means a plot on the fringe of the city, probably near or outside city limits, possibly with some improvements available. Suppose we estimate the cost of your lot at \$300. Some locations will be higher, some considerably lower.

By taking advantage of new building materials and methods, you can erect on this lot a five-room, all-metal, well-insulated and thoroughly substantial home for

as little as \$1,750, including the cost of construction. On such a home you can obtain a loan from your bank or home loan company up to eighty per cent of the value of the house.

So if your lot costs \$300, you have an opportunity to erect on it a modern five-room house costing \$1,750, erected, for a cash outlay of \$350, or twenty per cent of the value of the house. Your long-term loan can be liquidated like rent over a period of years, your small monthly payments totaling about \$200 per year.

Now, let's recapitulate. The first year is your big expense year. Your lot cost an estimated \$300, the down payment on your house is \$350, the first year's payments on your loan on the house represent about \$200, and your food bill is \$365—a total of \$1,215. After the first year, food and home payments—about \$565 per year—are your big items of expense. If you add to this taxes, depreciation and upkeep costs, your total expense after the first year should still be less than two dollars per day for food and home payments. And remember that part of this money is going to build up your equity in your home each year.

Is such a project feasible for the typical urban family with an income of \$1,062 per year? It is if the family really desires a home enough to save the small amount needed the first year to launch the venture. After the first year, this average income provides a margin of between \$300 and \$350 above the total amount of food bills and home payments.

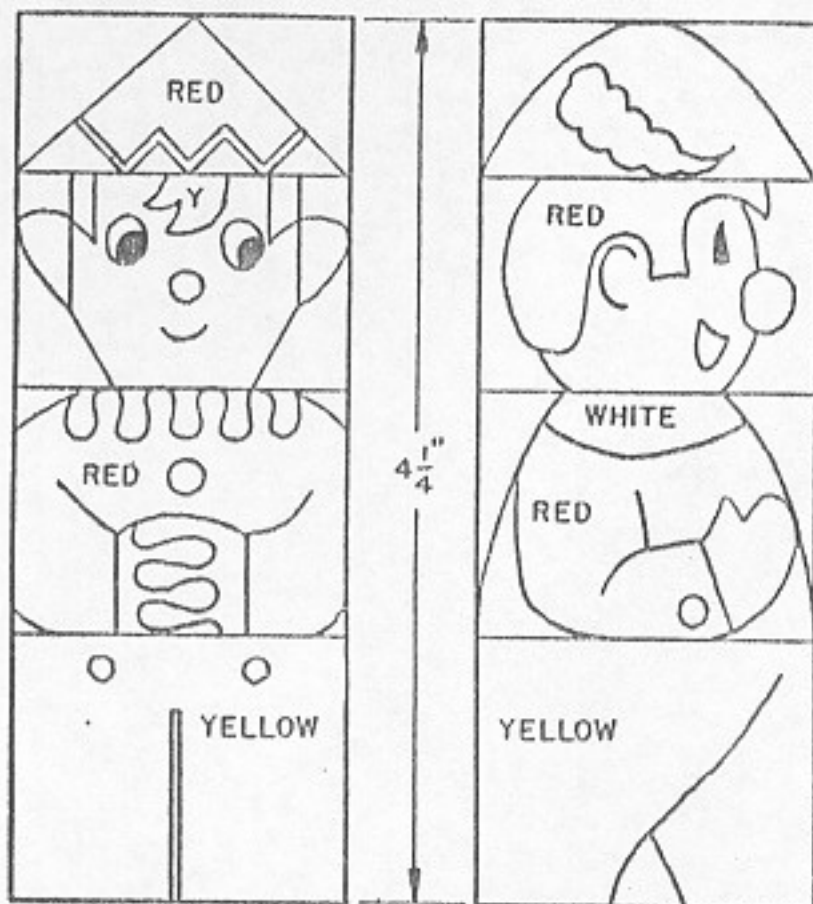
Once the lot is purchased, the ground itself can begin to pay for the house by reducing the food bills if it is made into a garden immediately. Thus the initial payment for the house can be augmented by the savings on food if the family income will not cover both the cost of the lot and the initial payment on the home.

As far as finding your half acre is concerned, just travel to the edge of your city and look around. A survey in the Chicago territory last year, for instance, revealed there are 254,000 arable acres within twenty miles of the downtown area. This represents more than half a million half acres, enough to feed 2,500,000 people. The same is true of almost any other American city.

Personality Pete

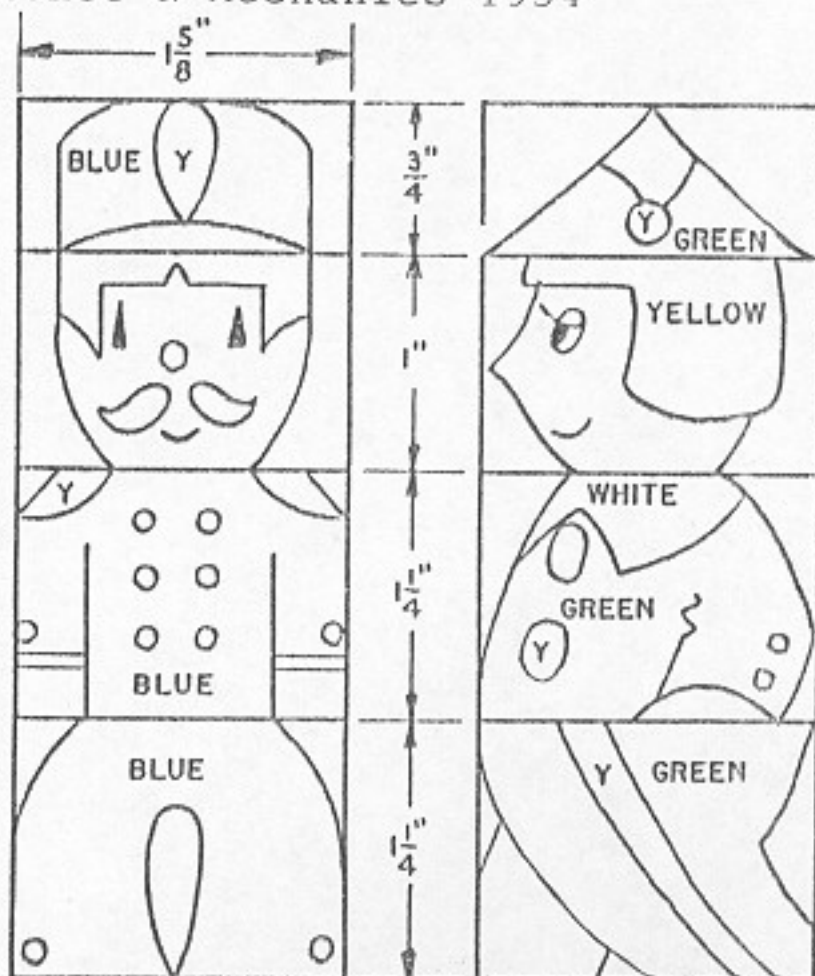
By ROBERTA L. FAIRALL

SECTIONAL figures on this turn-around toy rotate to create 96 laughable variations—or how many variations can you find? Draw the 4 basic figures on paper, trace them on $\frac{1}{8}$ in. hardboard and saw out the entire figure. Lay out and saw the base (feet) from $\frac{3}{4}$ in. solid stock or plywood scrap. Cut a $4\frac{1}{4}$ in. length of 2×2 in. surfaced stock and a $4\frac{1}{4}$ in. length of $\frac{1}{4}$ in.



CUT FIGURES FROM $\frac{1}{8}$ " HARDBOARD, GLUE & BRAD TO 2×2 " BLOCK, SAW APART & DRILL

Science & Mechanics 1954

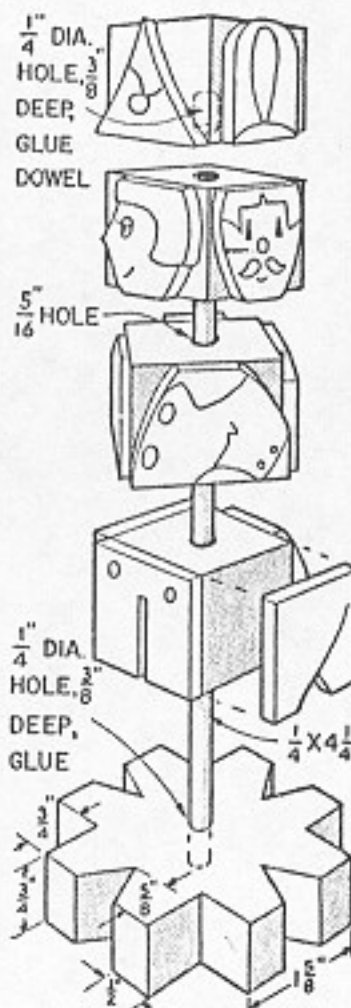


doweling as shown.

Paint the figures in flat white and decorate with enamels. Let one color dry before another is painted next to it, and add black last, putting in outlines with a fine pointed brush. Leave the 2×2 in. block its natural wood color and paint base section red.

Glue and brad hardboard figures to sides of block. Saw off hat section and drill a $\frac{1}{4}$ in. dia. hole $\frac{3}{8}$ in. deep into the center from underneath. Drill a $\frac{3}{8}$ in. dia. hole down through the block with the figures, then cut this piece into 3 sections as shown. Drill a $\frac{1}{4}$ in. dia. x $\frac{3}{8}$ in. deep hole into center of base.

Glue end of dowel in base, slip the three blocks, holding figures, over dowel, making sure they rotate freely. Glue top block over the other end of dowel. Finish toy with two coats of exterior spar varnish. Then watch your youngster's face light up when he meets Pete.



MATERIALS LIST—PERSONALITY PETE

Item	Size in inches	Material
Figures	$\frac{1}{8} \times 4\frac{1}{4} \times 6\frac{3}{4}$	hardboard
Block	$1\frac{5}{8} \times 1\frac{5}{8} \times 4\frac{1}{4}$	pine solid stock
Base	$\frac{3}{4} \times 3\frac{1}{8} \times 3\frac{1}{8}$	pine solid stock
Pivot	$\frac{1}{4} \times 4\frac{1}{4}$	dowel

"Odd" Foods of the Asiatic

By Orville H. Kneen

AMERICAN COOKERY June-July, 1932

THE disagreement between Chinese and Japanese, which would have been war anywhere else, has not been lacking in deeds of valor, of endurance and of strength. Neutral observers concede the fighting and physical abilities of these warriors.

Yet they live upon "queer" foods, which to us seem totally inadequate for a balanced diet. In fact, if we in the western world are correct as to what is good to eat, more than half the human race lives continually on "inedible" food!

Asia has for centuries been that strange world where men, women and children thrive, according to our Marco Polos, on strange dishes made from birds' nests, lotus roots, ferns, seaweeds, lily bulbs, even flowers and jellyfishes and the octopus family.

Scientists, however, find many oriental foods to be both nutritious and energy-giving. Viands which we would find no appetite for have been found to average somewhat higher in carbohydrates, proteins and fats, than our own favored foods!

As one scientist expressed it: "For economy, for strength-building, for ease with which meals may be prepared from them, few of these eastern foods are excelled."

Dr. Shih Tsin Tung, one of China's most widely known scholars, lately has told us why Chinese do not eat meat. He says:

"China is known as a country largely of vegetables. By far the most important food articles consist of cereals. Most of the Chinese people do not eat cattle meat, largely because of superstition, perhaps based on a real mercy to the poor hard-working beast. Cattle are kept in China

primarily to furnish power for the farm. Sometimes government officials even forbid, by heavy fines and bodily punishment, the slaughter of cattle. Cow milk is very rare."

What, then, does this great portion of the human race eat in place of our indispensable flesh foods, milk, cheese and eggs? Thousands of years ago the Oriental found — or evolved — the only vegetable in the world found by our Department of Agriculture to be a perfect substitute for animal foods. The soy bean is almost entirely protein.

"The soy," says Dr. J. H. Kellogg, "serves the Chinaman for both beef and butter. Chemical analysis shows that it contains more protein than beef. It is fully capable of supplying the place of lean milk or eggs. The Chinese and Japanese are able to prepare from the soy a very good substitute for milk. A very fine cheese is also made, which is in many respects superior to ordinary cheese. The fat or oil of soy is of excellent flavor and more easily digestible than animal fats."

Nor are these the only ways in which soy serves the human stomach. The dried beans are often roasted and eaten like peanuts. And "*shoyu* sauce," made from pulverized soy beans and wheat or barley grains, fermented for months or even years, makes an unequalled relish and cooking condiment.

Not only is this relish the great appetizer of the Orient, poured over every conceivable kind of food, but it is the indispensable base of our own famous Worcestershire sauces, found wherever white men foregather at the festive board.

Professor J. Russell Smith, of Columbia

University, author of "The World's Food Resources," has made a thorough study of the soy bean. In China and Japan, he finds, "the chief dependence is the soy bean, a nutritious legume with three times as much protein as wheat. The soy bean has been an important article of diet in China for at least 5,000 years — perhaps for 50,000. This bean is as new in the American dietary as the airplane is in transportation, and it promises to be as revolutionary in its field."

Miss Caroline L. Hunt, long a specialist in food and nutrition of our Department of Agriculture, also favored the soy bean as a new and useful food:

"Although the soy bean as an article of human food has attracted attention from time to time in the United States, thus far it has been used but little except as special food for invalids. The beans contain only a trace of starch and are highly recommended as a food for persons requiring a diet of low starch content."

Thus does the ancient race of the Chinese offer a very practical solution to the worldwide problem of girth control. Also to the gradual lessening of our open ranges and consequent reduction of meat supplies, which in years to come will inevitably bring higher prices.

A former United States Consul General in Japan, interested in food sources of the island empire, counted over two hundred and fifty varieties of seeds and grains used for food, from the universal rice to millet, rye, barley, wheat and Indian corn. He found over forty kinds of beans and peas alone.

His list of fruits and vegetables, as long as one's arm, ranges from most of our own staples to such novelties as lotus root —

"eaten raw, cooked and pickled," fronds of ferns, sea kale, mustard leaves and seeds, together with sixteen kinds of lily bulbs "boiled with sauce and sugar and a little sake."

"The sweet potato," he reported, "in quantity and quality takes first place of all Japanese tubers. It is probable that it enters more largely into the diet of the people than any other food plant, except rice. This is owing to its prolificacy and consequent cheapness."

Giant radishes likewise aid the Japanese diet — and perhaps also develop wrestling technique — for the white "daikon" grows to a length of three feet or so, and weighs over fourteen pounds at its largest, with an aroma in proportion.

Nor are flowers neglected as food. We eat seeds, fruit, young shoots and roots of plants. Why ignore the blossoms? "Chrysanthemum leaves and flowers are boiled and eaten with sauce. The root is boiled and eaten with sauce and sugar. Poppy seeds are dried and powdered and used for condiment. Sunflower fruit is dried and eaten raw with sauce. The dog-tooth violet and bulb are preserved."

"Here is a race of people of good physique," reported this former Consul General to Japan, "of stalwart and well-proportioned frames, although not tall, and of cheerful dispositions, who perform daily tasks requiring great strength and endurance, undergoing exposure unknown to our people, who eat almost exclusively this vegetable food."

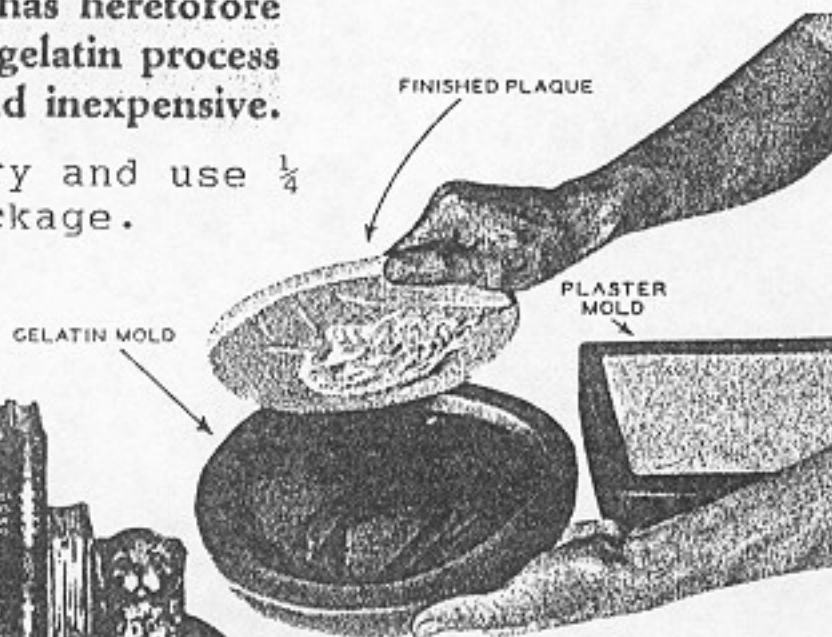
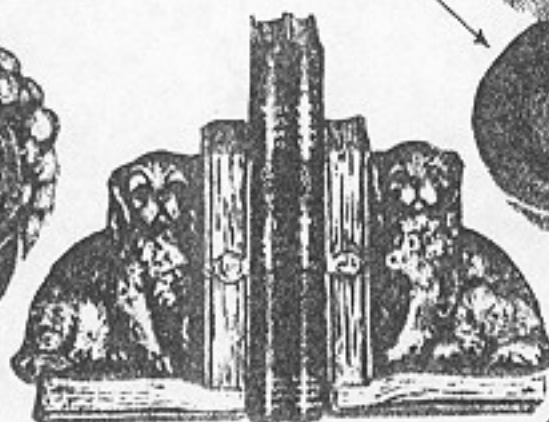
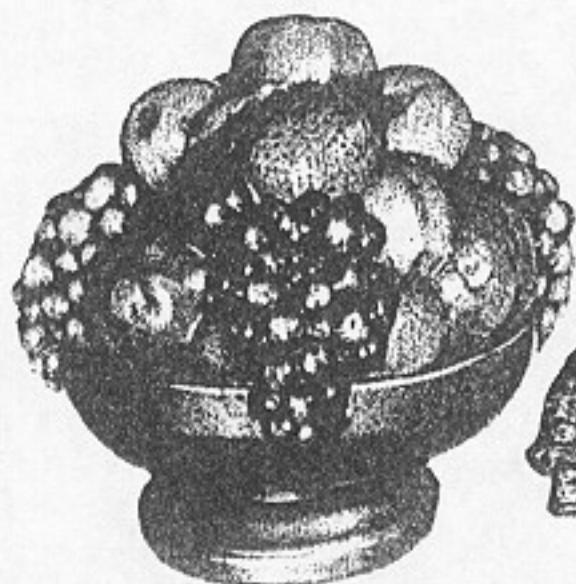
In some ways, too, we can learn about foods from races which have thrived so many centuries on limited food supplies, and have become tough and vigorous in the process.

Mold PLASTER Novelties With Gelatin

Though the making of plaster composition novelties with flexible molds is a pleasant as well as profitable occupation, information on the subject has heretofore been difficult to obtain. The molding gelatin process explained here is surprisingly simple and inexpensive.

Buy Knox Gelatin at the grocery and use $\frac{1}{4}$ the water asked for on the package.

Modern Mechanix April, 1935



Fruit bowls, book ends, and plaques like those shown above are easily made in quantities from plaster composition by flexible molding process described in detail in this article.

IN THE making of plaques, statues, book ends, or other plaster novelties on a production basis, a knowledge of flexible mold making will prove invaluable. Model makers, too, can save time and money with these gelatin molds especially when large numbers of an intricate plaster fitting are needed.

Molding gelatin has many of the characteristics of rubber, being flexible, elastic, and tough, yet it will melt at a temperature even less than that of boiling water. The gelatin may be used over and over again by remelting.

The making of the form is the first step in this new molding process. The model being copied is glued flat side down on a smooth board or piece of tin. With strips of wood or tin set up a form about $\frac{1}{2}$ " higher than the model and at least $\frac{3}{4}$ " away from it at all points. Cement down the outside edges of this form with a thick mixture of molding plaster and water, and allow to set.

If the model used is painted, give it a coat of clear varnish to protect the finish. If it is marble or a plaster composition, warm it up a little before pouring on hot gelatin, to prevent cracking.

The molding gelatin usually comes in flat slabs about $1\frac{1}{2}$ " thick. Cut this up into $1\frac{1}{2}$ "



Above—Plaques may be easily lifted out of gelatin molds, and mold used over and over again. Below—Model in form is ready for pouring with molding gelatin. Metal form is backed up by plaster mixture to prevent loss of gelatin.

squares, and melt in a double boiler. Allow the water to boil slowly until the gelatin is thoroughly melted, but do not allow the gelatin itself to boil.

Pour the gelatin slowly over the mold, allowing it to level itself to prevent formation of air pockets. Allow several hours to cool.

Now remove the form, and pull the gelatin away from the model. With room temperatures of less than 50 degrees the mold may be used just as it is, if the plaster is mixed with cold water. In warmer rooms apply two coats of a slow-drying varnish to the inside of the mold.

When you are ready to start molding, grease the inside surface with ordinary raw linseed

oil. Use about $\frac{3}{4}$ cup of cold water to each cup of molding plaster when mixing, to make a thick, creamy mixture which will level itself when poured. Fill the mold level full, allow to set a few minutes, then smooth off the top surface with a trowel or large knife.

Allow about one-half hour for the plaster to set, then remove the mold. The mold can be used over and over again, regreasing each time.

Allow the plaques to dry for several days, then fill up the pores in the plaster with a coat of ordinary shellac, white lacquer, or white enamel. Oil paints can now be used in finishing the product in color.

AMERICAN COOKERY

Advertisement January, 1934



MRS. GREEN

**Made \$86.20
First 2 Months
—\$350 in
6 Months!**

MRS. JEWELL GREEN, living in a small town in Michigan, started, in March, my home-study course in "Cooking for Profit, Catering and Food Service Management" and my supplementary course, "Blue Ribbon Cookery." Soon after she writes:

"Dear Miss Bradley: Had an enjoyable time at my little advertising party. Sold enough baked food to more than pay for all my material. . . . I think I have lots of nerve to start anything at my age — 60, but I am enjoying it."

On May 15, she reports: "So far I have received \$118.10 for my 'Blue Ribbon' Foods which gave me a profit of \$86.20." Early in October her letter says: "I have had a wonderful summer. . . . Total sales for meals and home-cooked foods, \$358.80, plus the \$118.10, equals \$476.90 — profits about \$350." Somewhat later she reports total profits of over \$500! (Full story of Mrs. Green's successful experience sent on request.)

Hundreds of other homemakers, without neglect of home duties, now enjoy a good income from the sale of my "Blue Ribbon" Foods and from catering. Later, after having gained experience, many of them have developed their food shop into tea room, motor-inn, guest house, and small hotels — *out of their profits!*

Many others have taken my thorough training and fitted themselves for excellent positions as managers of cafeterias, lunch rooms, tea rooms, and as food manager and dietitian in schools, country clubs, homes and sanitariums.

How to Make Potpourri

The rose-jar kind of potpourri is made by collecting rose petals of any kind and any color, only provided they are rich in perfume, and exposing them to strong sunshine, spread on a sheet, until they are dry and crisp. Then put them into rose jars. They will keep a long time and emit a sweet fragrance into the room when the lid of the jar is lifted and the petals stirred up.

A potpourri of mixed flowers is made by collecting both rose petals and other sweet-smelling things like lavender, verbenas, bay leaves, the blossoms of the lime, syringa, and even musk, and drying them in the sun as you did the rose leaves alone, then storing in jars.

Both kinds of sweet mixtures often have spices added, such as orris root and cloves, but we like ours best unspiced.

As for your scruple about the propriety of asking us how to make potpourri, we beg you will set your mind at rest about this or any other question that deals with matters of interest to women. Our little magazine is not confined to cookery alone, and the member of our staff who answers queries may possibly be able to answer a few outside to matters of the table and table etiquette. Just try her, and if she has to say she does not know, she may be able at least to direct you to the best source of information.

Green Pepper Butter

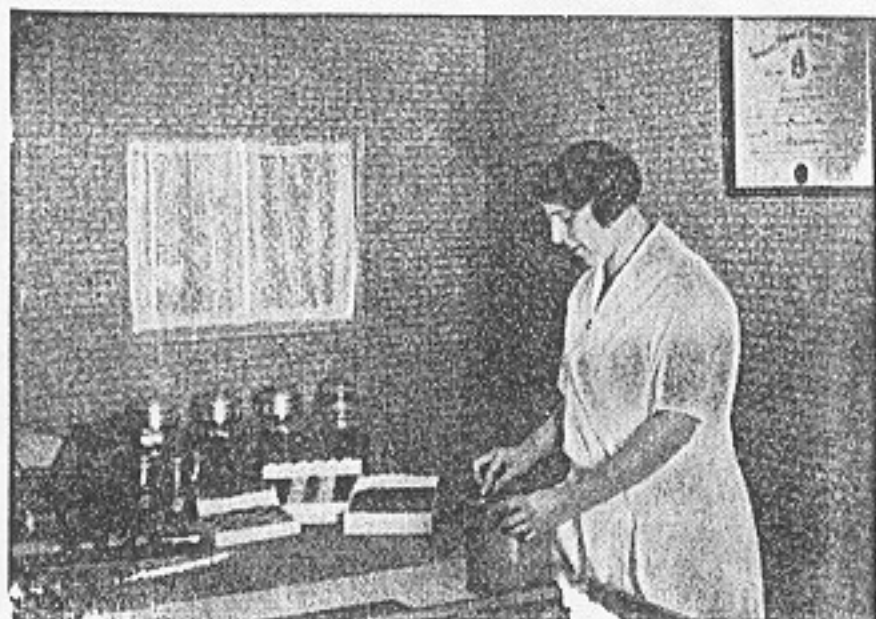
To make green pepper butter you should first remove all the white seeds and all the white centers from your peppers, then steam the green shells until soft, press them through a colander or a purée sieve and mix them with butter that has already been creamed to whiteness. The butter may be used for a sandwich spread, or to mix with a salad, or to garnish cold meats, or to put on hot chops or steaks, or to eat with baked potatoes, or in lots of other ways.

Candy

With a Few Hints on How to Make it

By Francesca V. Balch

AMERICAN COOKERY January, 1934



**6 Months' Candy Profits \$803.32
2000% on Her Investment!**

The simplest form of candy — and who as a child has not tried making it? — is molasses taffy. I recall my own first experience, boiling the molasses and pouring the brown, bubbling mass into buttered pie tins. When it cooled sufficiently, it was cut into squares with a knife and eaten in a highly chewy state. True taffy is *pulled*, and, incidentally, back in the early seventies, it offered possibilities of expansion to John Huyler who conducted a small bakery shop at the corner of Eighth Avenue and Jane Street, in New York City. My grandmother has told me how, as a little girl, she stood and watched John Huyler pulling molasses taffy back of a small counter at one end of his store. Later, Huyler's candy was to become quite an American institution.

My own adventures in candy making began properly when I was a schoolgirl and were conducted after school in my

1934 advertisement

MISS MARGARET RICKMERS, of Cleveland Heights, Ohio, started to learn candy making in September from Alice Bradley, Cooking Editor of "Woman's Home Companion." Her first month's orders amounted to 65 pounds and the demand for her candy increased so rapidly that she gave up her secretarial position to have sufficient time for candy making. By Christmas her profits were \$219.25, and her net profits soon amounted to over \$1,000. "The best investment I ever made," she says. Let us send you the complete story of her successful experience.

own home in Westchester or in the homes of girls I knew. We made fudge, of course, and rarely waited for it to become hard before we began eating it. Often the hardening process was accelerated by placing the fudge in the ice box, from which it was taken, as soon as was possible, and eaten ice cold. This was fudge made, alternately, from different girls' recipes, and consisted usually of cocoa, sugar and milk and a lump of butter, with sometimes the addition of some chopped walnuts.

Today, the ingredients are identically the same, but oh! — in the words of Wordsworth — "the *difference* to me!" For the fudge of my girlhood and the fudge of my maturity were two quite entirely different things. As fudge forms the starting point of most novices' adventures in candy making, I think it might be well for me to outline in brief the means whereby I have found, through years of experience, excellent fudge may be made. For fudge,

all else to the contrary notwithstanding, still remains the candy that is nicest when made at home. Commercial fudge is almost always a disappointment. The seasoned fudge maker — and eater — will know what I mean.

In going in for candy making in a serious way, let me recommend that you first purchase a candy thermometer, for it is impossible always, I feel safe in saying, to get accurate results without one. Second, in your items of paraphernalia, is a marble slab. Don't misunderstand me! An old-fashioned table top supplied me mine. Third, is a good wooden spoon, a single blade chopping knife and a pastry brush. If copper utensils are available so much the better; if not, an old-fashioned iron kettle is excellent; and, failing this, aluminum or enamelled ware may be used. After all, good results are obtained by the candy maker herself — not by her apparatus.

After innumerable experiments in fudge making, the following recipe is the one, I may say, which I have found to be the best. It combines certain economical features with its other values, which in these times is something not to be ignored, and it is quickly and easily made. I recommend it heartily for all beginners in candy making.

Take three cups of sugar and add to them six level tablespoons of cocoa, or, if you prefer, three squares of cooking chocolate, grated. Blend, and add one-half a cup of evaporated milk, three-quarters of a cup of cold water and one-half a cup of sweet milk. Put on to cook, and cook, according to your candy thermometer, to 235 deg. Fah. — or the soft-ball stage. Remove from the fire and add one tablespoon of butter, one teaspoon of vanilla and a pinch of salt. Stir and then pour upon the marble slab.

Now, let cool slightly, and take your chopping knife and scrape the mixture to one end of the slab. Work with your wooden spoon until the mixture begins to harden. You will note the change in texture; the mixture acquires a velvetlike smoothness. When this is accomplished,

fold into it one cup of broken walnut meats. Then, transfer to a slightly buttered pan and mark for cutting into squares. When it has become real cold, dip a sharp knife into boiling water and cut as desired. Constant dipping of the knife into hot water while cutting will be found to be necessary; but if you do exactly as I have outlined I am sure your friends will tell you they have never eaten creamier fudge.

The value of the marble slab is that it supplies a hard, smooth surface for the mixture to be pressed against, and it is this, I think, that produces the supreme quality of creaminess. The old-fashioned method, I'm well aware, was to beat the fudge mixture with a spoon. Many were the warnings, I recall, not to stir the mixture while it was cooking, nor to begin beating it until it was absolutely cold. Ah, well! We live and learn. No method, let me repeat, is comparable to the one I have mentioned which involves the use of a marble slab.

Penuche, I may add, can be made in identically the same manner. Here is a recipe for the latter which I like immensely: Take four cups of brown sugar and two-thirds of a cup of milk and mix; add one tablespoon of butter and a teaspoon of vanilla. To this may be added any nut meats that you prefer—pecans, almonds or walnuts. Incidentally, I have used this mixture as a center for bonbons — coating it with fondant or melted chocolate — and I have found it to be excellent. Of that, however, more in due time.

Fondant is the basis of most modern candy making of the better sort, and is so adaptable that it allows the cook the widest latitude in shaping it into different varieties. One jar, for instance, of ripened fondant will yield dozens of totally different and delicious sweets — bonbons, chocolate creams, cocoanut creams, mints, butter creams, coated nuts, as well as almost any other combination you prefer, and that you find usually in any high-

class box of store candy. The "ripening" of the fondant consists merely in placing the mixture in an air-tight container within the refrigerator for several days before using it.

The beginner in candy making is sometimes apt to be deterred by what she may consider are the intricacies of the art. I know it was so with me. I hesitated for a long while before commencing, for somehow it seemed the most complicated process in the world. Yet, when I did begin it and accomplished it, I found it no more intricate and complicated in its way than the making of fudge. The principal thing to remember, I discovered, before undertaking any candy making at all, is the proper choice of a suitable day for it. Fondant must be made when the weather is clear — not when it is rainy or even overcast.

My own recipe for fondant is as follows: Take four cups of granulated sugar, mixed with one-quarter teaspoon of cream of tartar, a pinch of salt and one-half a teaspoon of glycerine. To this add two cups of water. Put on to boil and boil without stirring until your candy thermometer registers 238 deg. Fah. Be sure to brush off the grains of granulated sugar that adhere to the sides of the pan with a pastry brush dipped in cold water. When the mixture reaches the specified boiling point, remove from fire and pour out very slowly upon the marble slab, proceeding as you would with fudge. Then, when the mixture becomes thick and creamy, and cool enough to handle, knead with your hands until it is perfectly smooth. When this is accomplished, it is ready to place in a tightly covered container and set in the refrigerator, or any other cold place, for several days, in which to "ripen."

This is your basis, your foundation, for practically all the candy you may make. For, from this, you fashion any combination that you yourself may desire. A favorite of mine is chocolate butter creams.

For these, take one-third of your recipe of ripened fondant and pat it out flat upon the marble slab, making several indentations. Then, slowly pour into these indentations one square or two, as you desire, of melted unsweetened chocolate. Now, butter your hands and combine the two by kneading. After this, work in one tablespoon of butter — soft but not melted.

Your mixture is now ready to shape into little balls which, when hard, can be dipped either in chocolate or in melted fondant. To melt fondant, place one part of the fondant mixture in the top of a double boiler, and, if a vanilla flavor is desired, add a small quantity of vanilla. The fondant may also be colored as desired, but care should be exercised not to use too much coloring, for the candy should be delicate in tone, not brilliant. Drop the centers in the fondant one at a time and remove to waxed paper which has been buttered beforehand. From this will be seen the endless varieties that are offered to the candy maker's skill. Indeed, she may pattern her own products quite after those of the stores.

Chocolate dipping, so called, is probably the trickiest phase of all candy making. It is conditioned by temperature almost entirely, and temperature not only of the chocolate itself but of the room in which the dipping is done. Expert chocolate dippers are real artisans at their craft, the work requiring intense precision and a high degree of speed. My own powers, I confess, leave much to be desired. However, when I do turn out a tray of chocolate candies that are perfect in appearance — the rich, glossy blackness of the perfectly dipped chocolate, unmarred by any pale streaks — I am inordinately proud of them, as an amateur may well be.

The exact quality of chocolate used in making chocolate-covered candy is really immaterial. I remember, some years ago, when I was new to candy making, a day in which I searched all over New York for

a shop selling, as I conceived it to be, confectioner's chocolate. No, it was not the chocolate, I was to learn subsequently, that made the difference, but the method used in handling it. It is all, as I've said, a question of temperature. And the chocolate used, whether sweet or bitter, is solely a matter of individual taste.

Personally, I prefer a chocolate mixture that is half bitter and half sweet. This gives me, for coatings, just the right blend. I take a desired amount in equal parts of each and melt it over hot — not boiling — water. Then, I allow it to cool to eighty degrees, which is the correct temperature for dipping. But here the trouble commences. For the problem is to maintain this temperature while the dipping proceeds. This is why speed in dipping is essential and why the temperature of the room must conform, more or less, to that of the melted chocolate.

Note this. Once you have learned the simple process of fondant making, you will never care to be without a jar of it in the house; it will be as essential to you as — well, as French dressing. And once you have eaten your own cocoanut bonbons, you will find the store and package variety an utter disappointment. The cocoanut bonbon, incidentally, is one of the most economical candies to make, just as it is one of the most delicious, for a small amount of the fondant goes a long way. Directions are easy. You simply work into the fondant as much shredded cocoanut as is possible, then shape into little balls and dip.

Mints, in particular, offer an excellent medium for the beginner's hand. They are easy to make and they are nice to serve at the conclusion of a meal. Take your entire recipe of ripened fondant and divide it into three parts. Melt each part separately in a double boiler and flavor, respectively, with wintergreen, peppermint and clove. If desired, you may then color them green, pink and yellow. Now, drop from the end of a tablespoon on buttered waxed paper.

You will find this simple process makes dozens of beautiful after-dinner mints, of which I'm sure you will be very proud.

Candy should always be kept, let me hasten to remind all prospective candy makers, in tin boxes. This keeps it fresh practically indefinitely. I keep mine in the circular tins in which Christmas fruit cakes are sold, and it is amazing how little it ages in these homemade humidors. Bonbons or chocolate creams a month after making are quite as fresh and as tender as they were the day they were put in. Indeed, I really think keeping them improves them. The candy, like the fondant, "ripens" with age.

Thus, candy, the ancient sweetmeat, with a few of the first principles of its evolution out of sugar, milk, butter and chocolate! Verily is it a food and a tonic. My dressmaker, a Bavarian, tells me that in her youth, in "ould kontree," it was the daily custom, upon arising, to drink a tablespoon of strained honey in a cup of cold water. It made you "feel so goot," she explained. Of course it did, for it contained the tonic property of sugar, which is one of our greatest energy-producing foods. Those Bavarians acted no doubt by instinct; they took the honey and water because they found it stimulated them; nor were they very far wrong, either.



Carrot Honey

Select fine young carrots, and grate, measuring one pint and one-half. Add the juice and grated rind of two lemons. If the bitter flavor is liked, the entire rind may be used, including the white inner portion which contains some pectin. Cook slowly. The lemon may be cooked separately before combining with carrots, to be sure of tenderness. Add two cups of sugar, stir as it becomes clear and thick. Pack into clean, hot jars, and seal tight. Serve with cold meats.

"MIRACLE

Roots of plants are suspended in a solution of chemicals providing a well-balanced plant food which is always in contact with roots and available for constant consumption



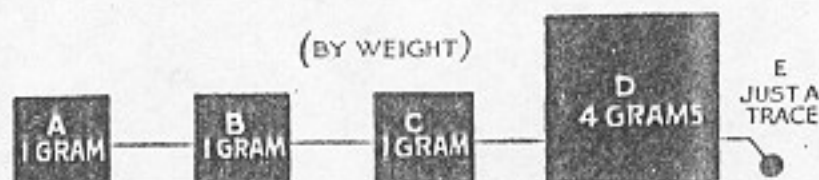
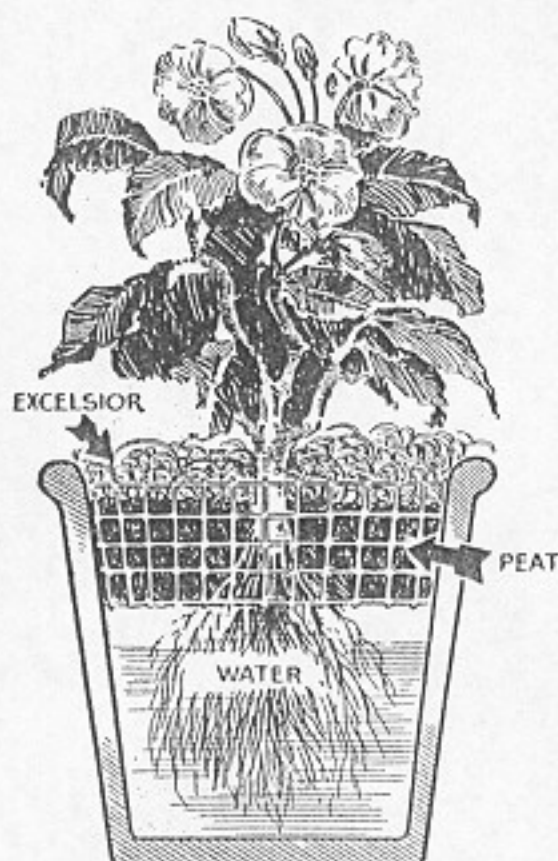
By POLLY MERRIMAN

Popular Mechanics 1941

PLANTS and flowers that are unusually large in size and are prolific bearers can be produced right in your own home. The process followed is known as nutrient-solution culture, and it enables plants to grow without any necessity of rooting in soil. The roots are suspended in a solution of chemicals which provide a well-balanced diet. In this way the roots absorb nutrients in better proportions than is ordinarily possible when food is being collected through a root system imbedded in soil, because all the food required for the plant is always in contact with the roots and thus available for constant consumption. Of course, the same solution applied to soil in which plants are grown will also cause them to thrive better than plants not provided with such additional nutrition.

The nutrient-culture process enables you to grow a plant in a test tube if you desire, or in any pot that will hold liquid. All you need to start such an experimental garden is some bottles of inexpensive chemicals which will cost only a few dollars; a pair of laboratory balances and a graduate for accurate measuring; some peat moss, excelsior, glazed pots and a flat of seedlings. Each pot must be fitted with a tray constructed of $\frac{1}{4}$ -in. galvanized-wire mesh, placed inside the top so that the mesh will rest about 1 in. above the surface of the solution when it is added. See sectional view of the flowerpot. The roots of the plant pass through the wire mesh into the solution and the foliage will rise above the pot. Place the pots where you would place them if you were growing plants in soil.

PLANTS "grow in liquid"



CHEMICALS MIXED TOGETHER, THEN ADDED
TO WATER 7 LITERS (1 LITER = 1.0567 U.S. LIQUID QT.)

A	POTASSIUM NITRATE (KNO_3)
B	POTASSIUM PHOSPHATE (KH_2PO_4)
C	MAGNESIUM SULPHATE (MgSO_4)
D	CALCIUM NITRATE ($\text{Ca}(\text{NO}_3)_2$)
E	FERROUS SULPHATE (FeSO_4)

Formula for a 0.1 Per Cent Plant-Food Solution

If soil-grown pansies do well in your sun-parlor window, you can grow them there in nutrient solution. If you must grow certain plants under glass in your part of the country, you'll have to keep your nutrient-grown plants in approximately the same temperature. Sufficient humidity also should be maintained when plants are grown indoors during the winter months.

Making up the nutrient solution is very simple. Use of ordinary city water is recommended because it usually contains minute quantities of manganese, zinc, copper, boron, aluminum, lithium, nickel, cobalt, iodine and sodium which are necessary but are not required in large amounts. If rain water is used, minute quantities of

Hydrangeas above were grown in a pot arranged as shown in the cutaway view and then fed with a chemical solution given in the table at the left

these elements must be added. Carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, manganese, calcium and iron are essential elements in plant growth and development. Of these, carbon, oxygen and hydrogen are obtained by plants from the air in the form of carbon dioxide and water. Nitrogen, phosphorus, potassium, sulphur, magnesium, calcium and iron must be supplied in form of salts. You buy these salts from any chemical supply house and mix your own solutions, using the quantities given in the table. It is in measuring the salts that the laboratory balances and the graduate are needed.

Now fill the pots to within 1 in. of the mesh trays with the solution. Spray the roots of the seedlings to remove the soil. Then slip the roots through the mesh so that they are suspended in the solution. Cover the trays with a 1-in. layer of peat moss. Follow this with a layer of straw or similar material to keep out the light. Then place the plants where they will have the same light and temperature that soil-



In small pots, you can grow plants 40 to 50 in. in diameter. The yardstick was not long enough to measure this one

grown plants would require. Every seven or eight days, renew the solution, gradually increasing the concentration, in a period of two or three months, from .1 per cent to .5 per cent for mature plants. Right here the opportunities for experimentation are almost limitless. Variations in quantities of each of these essential elements affect the plant's development. By slight modification here and there you can intensify color of blossom, lengthen and strengthen flower stalks, produce more foliage or more bloom. Begonias, cannas and other

flowers of a tuberous type, offer particularly promising opportunities for amateurs. You will find that, when grown in nutrient solution, they will materially increase both in size and number of flowers. Potatoes and tomatoes also flourish when grown in tanks, but experience is required before the amateur can expect as great reward from most other vegetables.



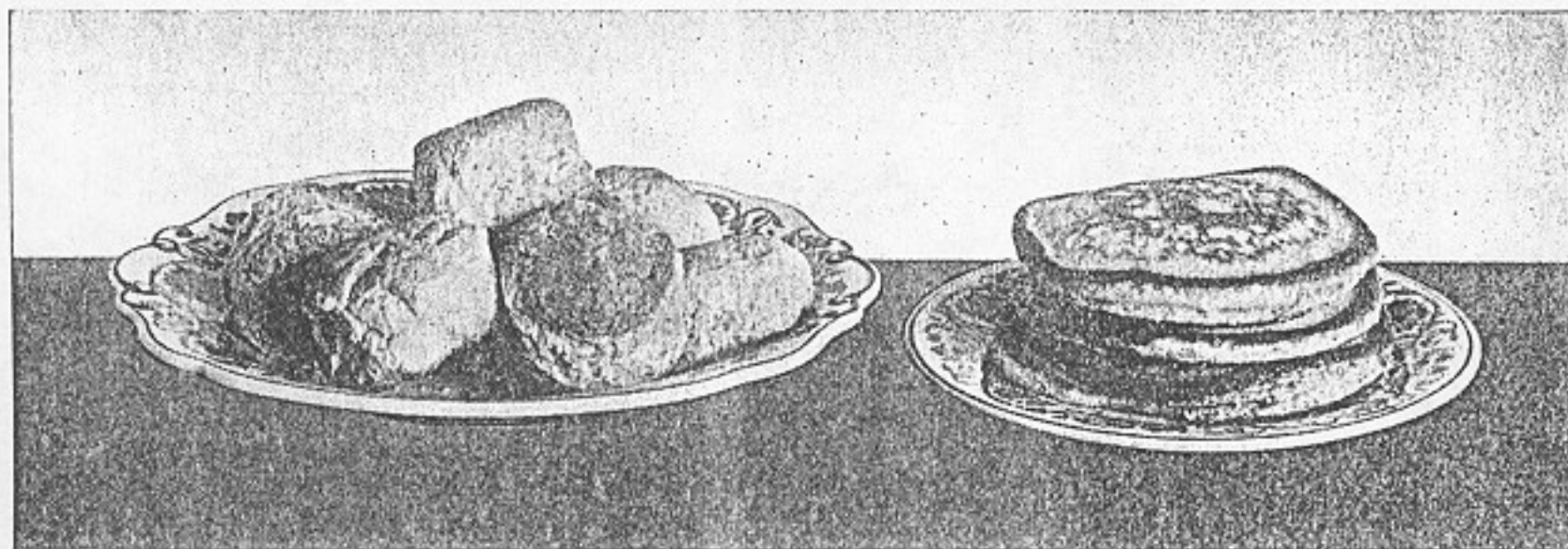
American Cookery June-July, 1932

Tomato Puree

Cook together five onions, three carrots, two stalks of celery, one sweet pepper, and one-half a peck of ripe tomatoes. When tender, run through a sieve or colander, season with salt and pepper, bring to a full rolling boil, and pour into boiled, hot jars. Seal immediately. This is good as a soup or cooking sauce. Upon opening the jars one may add chili pepper, or tabasco sauce. The purée may be cooked down thick before canning if preferred.

Strawberry Preserves

Cover two quarts of fresh strawberries with five cups of sugar. Let stand four hours. Bring to the boiling point slowly and carefully, that the berries be not crushed. Boil gently seven minutes after boiling point is reached, add one-half a cup of lemon juice, bring to a boil, and boil two minutes. This amount of time is ample, therefore do not overcook. Pour immediately into hot jars and seal.



BAKING POWDER BISCUITS

GRIDDLE CAKES

AMERICAN COOKERY June-July, 1932

Griddle Cakes and Baking Powder Biscuits

(The liquid used for both recipes combines one four and one-half ounce can of evaporated milk with water)

American Cookery was promoting evaporated milk. For biscuits you can use $\frac{1}{2}$ cup of regular milk and for griddle (pan) cakes you can use two cups of milk. You can also omit the sugar from the pancakes if you like.

Biscuits

Sift together two cups of flour, one-half a teaspoonful of salt, and four teaspoonfuls of baking powder; work in three tablespoonfuls of shortening (using two knives), add one-fourth a cup of evaporated milk and one-fourth a cup of water, a little at a time, mixing it in meanwhile with a knife. The dough should be as soft as can be handled. Turn the dough on to a floured board, turn it with the knife to coat with flour, then knead slightly; pat with the rolling-pin, and roll into a sheet about three-fourths of an inch thick; cut into rounds, and bake fifteen to twenty minutes in an oven at 400 deg. Fah. Brush the top of the biscuits with melted butter before baking to insure a brown crust.

Griddle Cakes

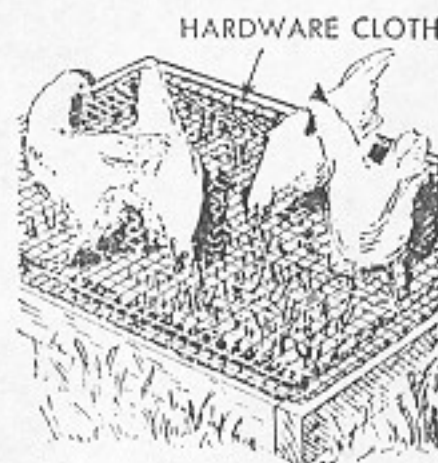
Sift together three cups of flour, four and one-half teaspoonfuls of baking powder, one teaspoonful of salt and two tablespoonfuls of sugar. Beat one egg, add one cup of evaporated milk and one cup of water, pour slowly on the first mixture. Beat thoroughly and add two tablespoonfuls of melted butter. Drop by tablespoonfuls on a buttered hot griddle. When cooked on edges, turn and cook the other side. Serve at once. Be careful never to beat or even stir the mixture in the bowl after beginning to fry the cakes.

Popular Mechanics 1951

Green Feed Grown in Poultry Yard Protected With Hardware Cloth

Small grain sown in a cultivated section of the poultry yard will continue to produce green feed for some time if the planted area is protected with a hardware-cloth screen immediately after sowing.

The hardware cloth is stretched across a wooden frame made from 1 x 4-in. stock. This keeps the chickens from scratching up the seed before it has had time to sprout, and also permits the poultry to eat only that portion of the feed which grows above the wire screen.

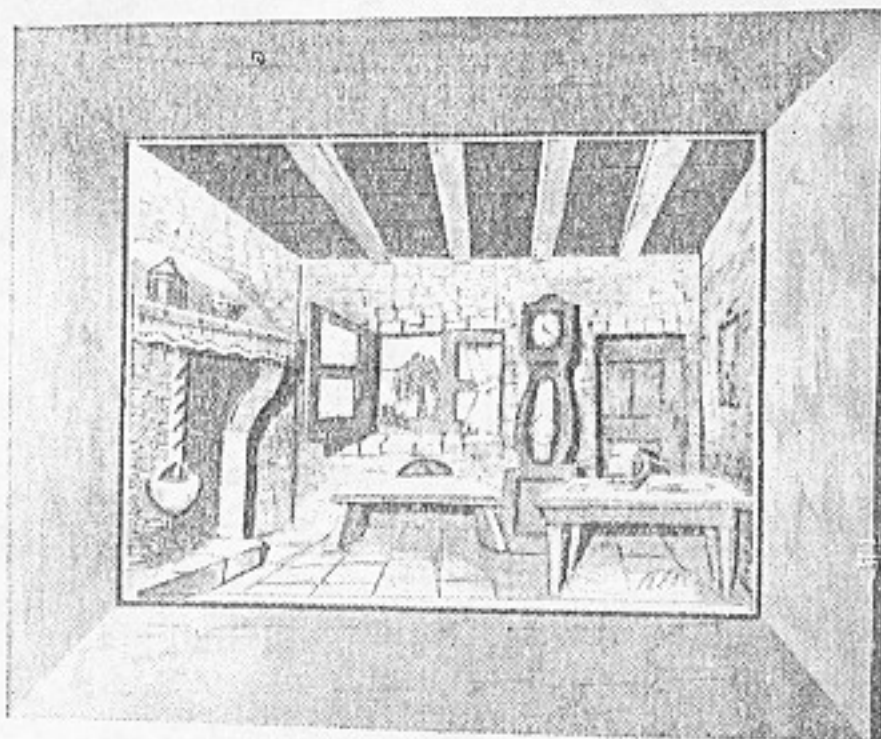


HARDWARE CLOTH

PICTURE CARVING in RELIEF

"PAINT" PICTURES with a jack-knife—carving in sunken bas-relief to give a striking third-dimensional effect. Carving is done in a plank only 2 in. thick. First enlarge the pattern in Fig. 2 and mark the vanishing point as given. The picture shown, depicting a Swiss kitchen, was carved $6\frac{1}{2}$ by $9\frac{1}{2}$ in. In enlarging the pattern, rule on paper the same number of squares as given below and then duplicate the scene by drawing the lines in each square in a corresponding square on the paper. Mark off a border around the picture $\frac{1}{4}$ in. from the edge and score the line with a knife.

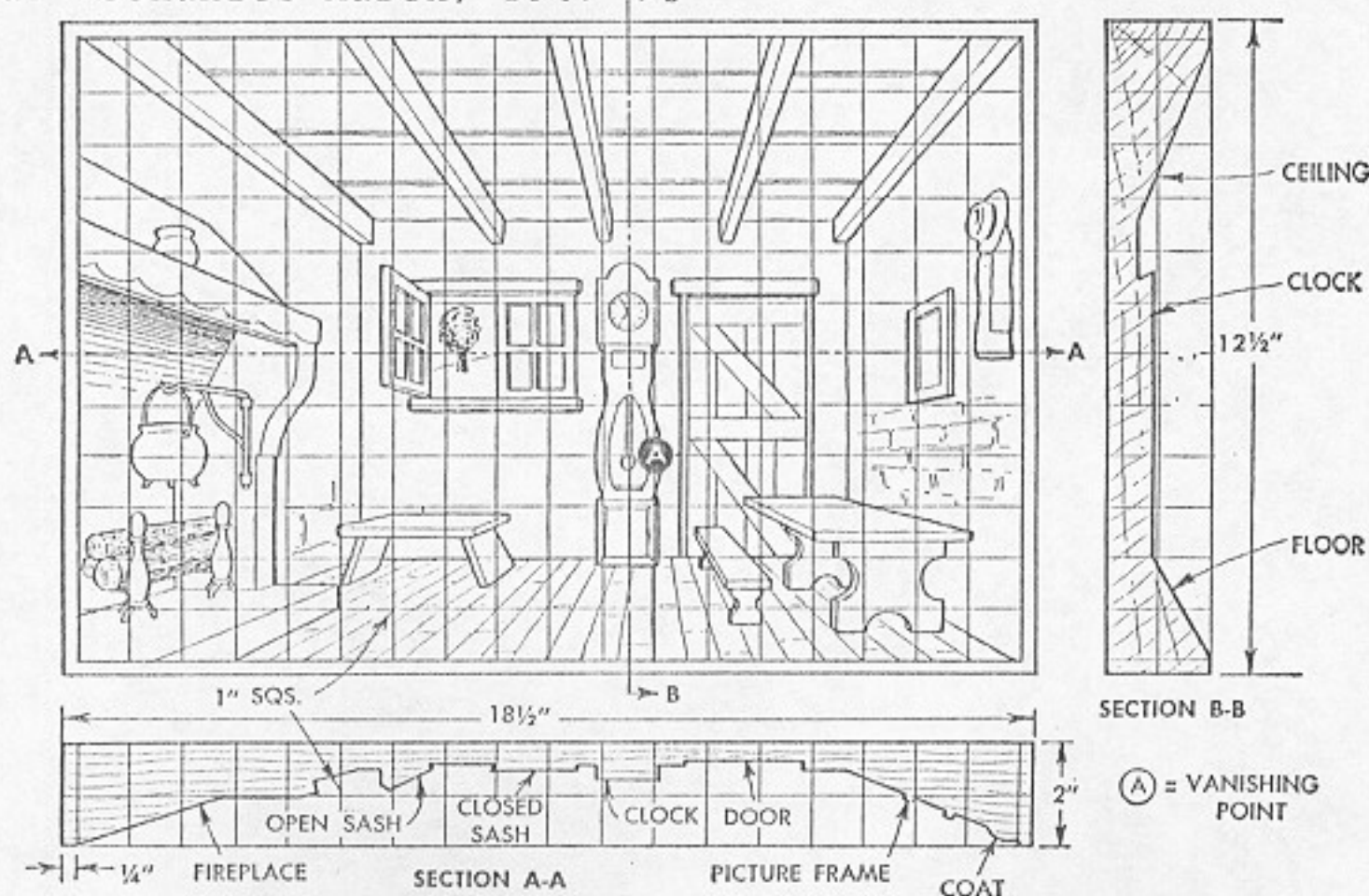
Start carving the ceiling beams and then outline the objects in the foreground, gradually cutting away

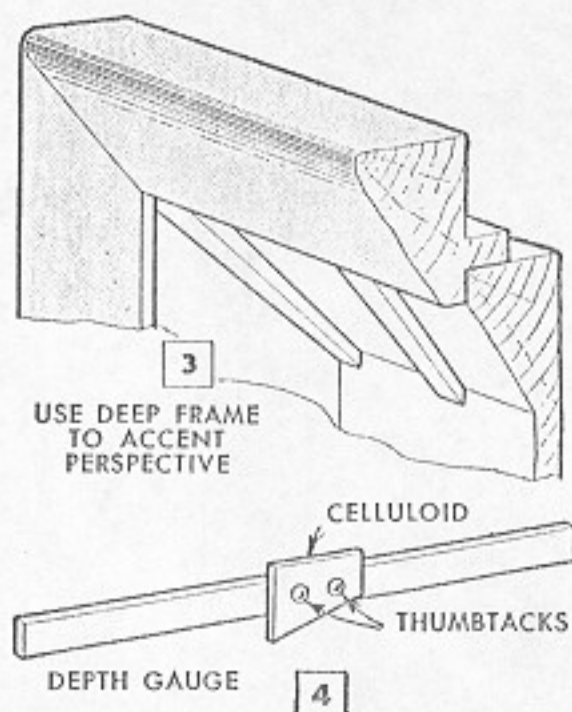


Completed carving mounted in wide frame. Landscape scene behind open window is represented by picture pasted in place



Popular Mechanics March, 1947





the remaining area. The three stages to follow in carving are given in Fig. 1. Work carefully and proceed cautiously. A depth gauge, Fig. 4, is required to check for depth at various levels. The gauge consists of a piece of celluloid or stiff cardboard which is fastened to a straightedge with thumbtacks. The gauge is set for depth by adjusting it to conform with sectional views A-A and B-B, Fig. 2, which also must be enlarged to actual size.

After the carving is completed, the next step is to make the deep frame, Fig. 3. Miter the corners carefully and form a tongue on the back of the frame. Sand it and then mount the picture by driving small brads through the tongue into the edge of the picture. Stain or color the entire project to suit and apply wax to the frame.

String Tricks

Harper's Young People, 1883

SLIP the string, with the ends tied together, over the post of a chair, passing the right-hand string a second time around the

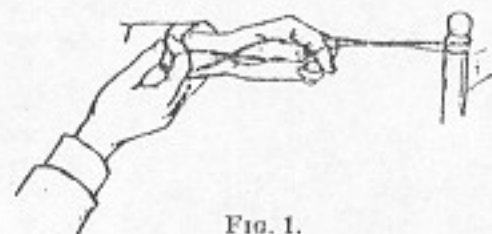


FIG. 1.

post to make your prisoner doubly secure; then with the forefinger of the right hand slipped upward through the opposite loop, hold the middle of the string with the left hand, as indicated in Fig. 1, passing the thumb under the first and over the

second string, and the forefinger over the first and under the second.

Holding both strings firmly in this position with the left hand, carry the loop held on your right forefinger over the left hand, and lay it, loosely spread apart, upon the double string in such a way that, having released your right hand from above, you may grasp the same loop from below, as shown in Fig. 2, by passing a finger through it on each side of the double string.

Observe carefully the position of the strings upon the left forefinger in Fig. 2, and be sure that the string which before passed under the thumb now drops below the forefinger. Now transfer the two loops from the left forefinger to the chair post, turning the hand so that the finger points toward you, in order that the loop nearer the base of the finger may pass first over the chair post, as shown at *a*, Fig. 2.

Finally, covering the top of the post with your left thumb, release your hold of the string, except from the middle finger of your right hand. By this finger the whole string may be drawn freely out of its apparent tangle, and, if done quickly, with the effect of having passed through the solid wood.

A more simple trick, not unlike this in effect, is performed as follows: Pass the string over the chair as before, without winding it a second time about the post. Follow the directions for the previous trick as far as Fig. 1. Then place the right forefinger, with the string still upon it, firmly on the top of the chair

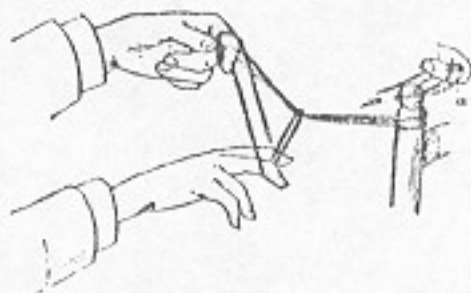


FIG. 2.

post, and releasing the string from the thumb of the left hand, use the forefinger of that hand to pull the string from the post.

In the two tricks which follow, not one finger, but four, seem susceptible to the free passage of your wonderful string. Thrusting all the fingers of each hand through an opposite end of the string still tied, use the right hand to bring the two sides coming from the palm of the left hand back between the fingers and around the thumb, precisely as indicated in Fig. 3. Then lifting the right hand, allow the lower string to pass again around the little finger, this time from left to right, and the upper string around the index finger from right to left, thus bringing the loop once more toward the palm, place it between the two middle fingers, letting it hang as in Fig. 4. With the thumb and forefinger of the right hand remove the two loops from the thumb, and pass these also between the middle fingers. Lastly, with the forefinger of the right hand passed under the string at *a*, you may release it entirely by drawing it toward you.

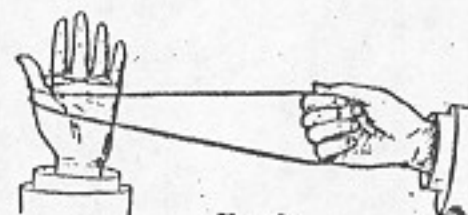


FIG. 3.



FIG. 4.

In the next trick you shall begin by what seems a thorough interweaving of string and fingers. With the left hand in the position of Fig. 5, begin at the little finger and weave

the cord in and out between the fingers in the manner shown at *a*, until you come to the thumb, when, after crossing the strings, you pass them both outside of the thumb, and then (without crossing) over the forefinger as in Fig. 5, which represents the trick thus far clearly.

Continue to cross the strings between the fingers as shown at *b*, Fig. 5, returning in this way to the little finger. Your hand will now seem quite surely tied fast—an illusion which you speedily dispel by slipping the loops from your thumb, and with your right hand drawing the string, whole as ever, directly through the base of all your fingers.

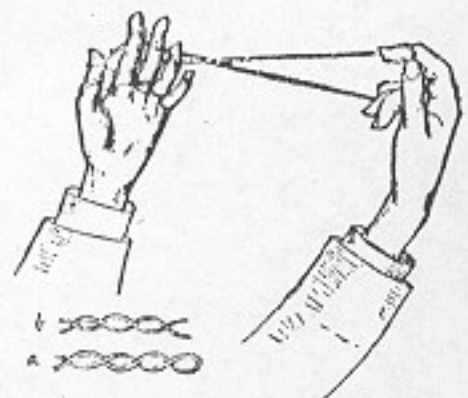


FIG. 5.

Gardening for Flavor

By Phyllis K. Ockert

AMERICAN COOKERY APRIL 1934

THE revival of interest in household arts and the constantly growing enthusiasm for gardening suggest the possibility that these two hobbies may well go hand in hand. The result of such an alliance is the Flavor Garden, which takes a good deal of its inspiration from the old-fashioned herb plot, something from the vegetable patch, and even from the flowerbed. Indeed, the Flavor Garden is often not a separate garden at all, but finds itself scattered through the perennial border and among the annuals.

The value and enjoyment to be obtained from cultivating savory plants are unlimited. One can number indefinitely the soups, salads, meats, beverages, and garnishes to be helped by flavorsome additions fresh from the garden. Whether the Flavor Garden is only a pot of chives on the window sill, or a large and elaborate herb plantation laid out with pebble walks between the beds, the profit to oneself in growing it is very great.

The first things that spring to mind in connection with flavor from the garden are Mint and Parsley, found in even the smallest vegetable patch. But they need not be confined to that utilitarian spot. Parsley, that indispensable leaf for flavoring soup and casseroles, and for decorating the fish and meat platter, is easily grown from seed, and the thick-growing dwarfed and curled varieties make lovely edging plants for the flower border. In the fall a clump of Parsley can be taken up and potted to sit all winter on the kitchen window sill next to the pot of chives.

Mint deserves a whole volume to itself. Even the smallest yard should have a

clump, planted in a corner away from other plants if possible, where it can be weeded out and pulled back when it tries to spread from its corner. Mint has dozens of possibilities as a flavor beside its traditional uses in mint sauce and mint jelly with lamb. A leaf or two in the kettle with peas or carrots brings out, without subduing their flavor. A sprig of Mint is as delightful in hot tea as in iced tea, and it adds zest to a fruit salad or a fruit cocktail. Another interesting use for Mint is with apples. A few leaves are good stewed with the apples for sauce, or chopped Mint added to the brown sugar and raisins that stuff a baked apple raises that apple far above the commonplace.

Mint has its appeal to the eye as well as the palate. When it is in flower its slender, delicate lavender spikes are lovely in a bouquet, and there is a variety with green and white striped leaves that is very decorative in the garden. Every Flavor Garden should have not only the usual Spearmint but Peppermint as well. This has rounder leaves, and its flower spike is a little fatter and a deeper color. Peppermint is even more refreshing than Spearmint in summer drinks. A sprig of either kind looks interesting frozen into the center of an ice cube, especially if the cubes are tinted a pale green.

When one comes to consider the inhabitants of an old-fashioned herb bed, one finds a tremendous variety, but even the small garden can have a few, offering many possibilities. There is as much satisfaction to the housewife in picking fresh leaves from her yard to add interest and piquancy to the soup or the salad, and in having aromatic bunches of dried leaves

hanging in the provision room in the winter, as there is in contemplating her rows of jellies and canned fruits.

The perennial herbs, as well as the annual, for the most part can be raised easily from seed. They all like rather rich soil, and they need some winter protection. For the average family, two or three well-grown plants of each variety will be enough, planted in a little patch by themselves or scattered in the flower border. Fennel, Sweet Marjoram, and Thyme, all perennial, and Basil an annual, traditional and romantic names in the garden, are grown to use either fresh or dried as seasoning in soups or meat dishes or salads. A casserole takes on a new air if a sprig of Thyme, as well as Parsley and Chives, is added to it. Sage is usually dried first and used to season poultry dressing, but try also adding a dash to a meat loaf. The leaves of Tarragon, customarily associated with the flavoring of vinegars and pickles, are equally good chopped and added to a green salad. Many of these herbs are as valuable for garden plants as for kitchen flavoring. Fennel has beautiful leaves and Thyme is one of the nicest of edging plants. Borage, another annual, has lovely big leaves that have a fragrant odor and are nice served with lettuce in salad, and may also be boiled like spinach. The flowers of Borage have the further virtue that they attract bees to the garden.

If there is still room in the herb bed, Anise, Coriander, and Caraway, all annuals, should be grown. The seeds of these three plants are the desirable seasoning parts, and the ingenious cook will find plenty of uses for them, besides the old-fashioned one of flavoring cake. And while the family is enjoying its share of the Flavor Garden, pussy should not be forgotten. A patch of Catnip fits into the rock garden very well, and the bees like

this plant also, as well as the cats.

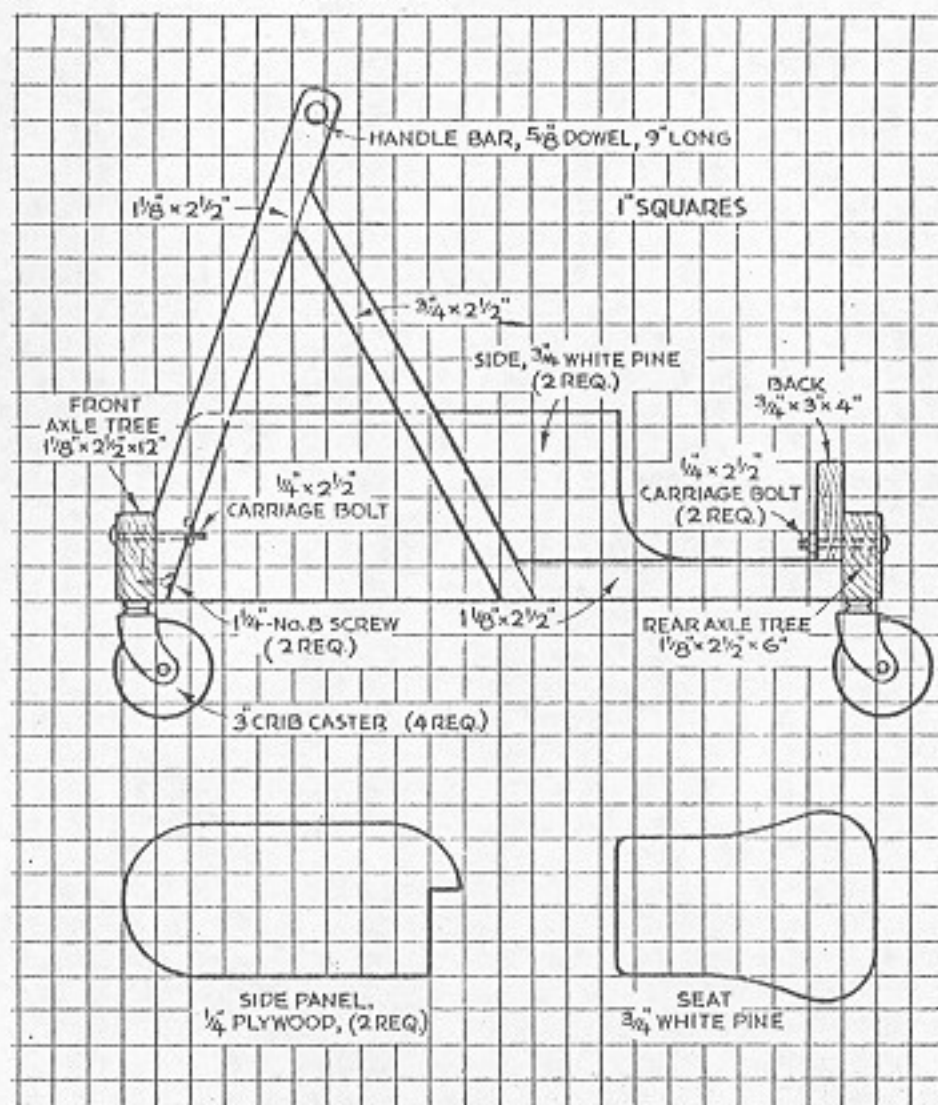
The flower bed proper has its own contribution to make to the seeker after unusual flavors. A fragrant Rose Geranium leaf placed in the bottom of a glass of apple jelly is the surprise that lifts that jelly above all the rest. The fresh leaves of Nasturtium are delicious in salad, but this plant's usefulness does not end there. From an old cook book comes the following recipe for Nasturtium Vinegar: "Fill a quart jar loosely with Nasturtium blossoms. Add a shallot and two cloves of garlic, both chopped fine. Add one-half a sweet red pepper and enough cold cider vinegar to fill the jar. Cover the jar closely and set it aside for two months. Then add one teaspoon salt, strain, filter, and bottle." This vinegar used in French Dressing will certainly put even the simplest salad on a very high plane indeed. From the same book comes this method of making Pickled Nasturtium Seeds: "As the seeds are gathered, wash and dry them. Put them into vinegar, adding one-half teaspoon salt to each pint. When all the seeds are ready, scald fresh vinegar, adding salt as before. Drain the seeds and add to the fresh vinegar. Bottle hot." These seeds make a delicious addition to salad or to mixed pickles.

Once started on a Flavor Garden the enthusiastic cook and gardener sees opening before her infinite possibilities. In the end she will probably feel that she needs at least an acre of land and a store room the size of an old-fashioned attic. The rewards from this garden are many — the fun of growing things, the satisfaction of surprising family and guests with unusual and fascinating dishes, and the deeper pleasure of having at one's hand the ingredients for artistic expression in originating new combinations of flavor.

How to build a

Caster Scooter for the Toddler

POPULAR SCIENCE DECEMBER 1955



A RIDING toy built for the toddling set must be simple to operate, for a child just learning to walk can't cope with pedaling or steering. But put a toy on big, easy-rolling casters and he instinctively maneuvers it to his heart's content. Add a wagon compartment and you have a toy that will remain a favorite for months. Construction is simple but rugged; the original has been in use for several years and is still going strong.

After completing the body, make up the axle trees (shown on the facing page), and drill holes $\frac{3}{8}$ " from the ends for the casters. Your hardware dealer calls them 3" rubber-wheel, grip-neck casters.

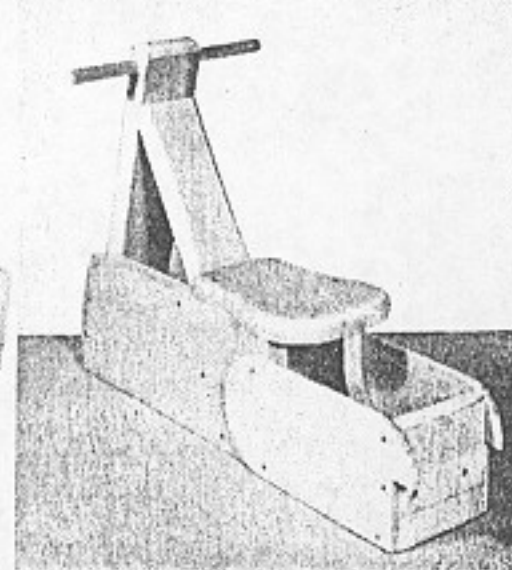
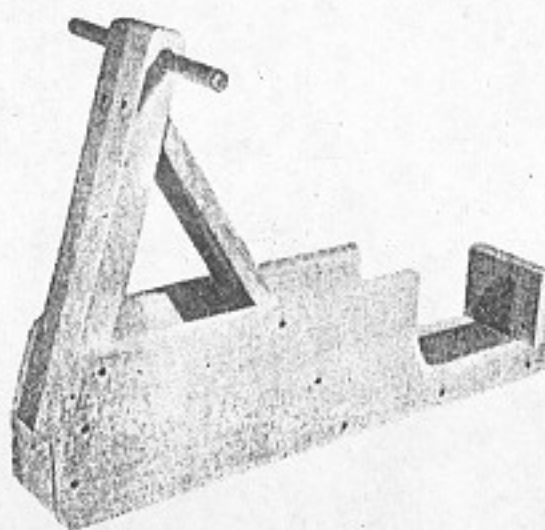
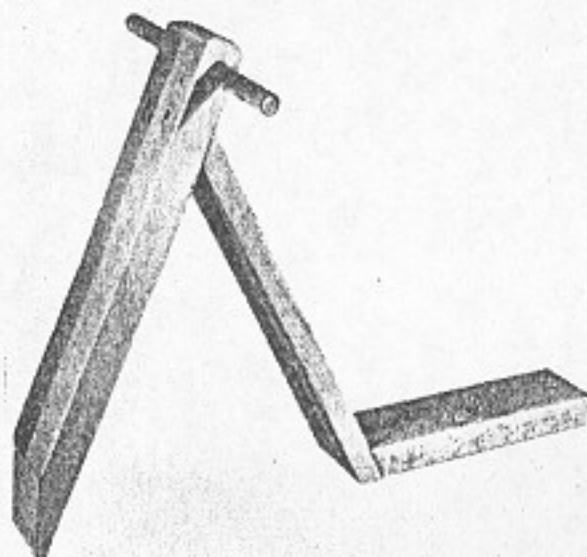
The original was finished natural with the exception of the seat and wagon compartment which were painted red. To complete the job, cut a wrap-around bumper from discarded rubber hose. Handle grips are $\frac{3}{8}$ " white-rubber crutch tips (size 17).—

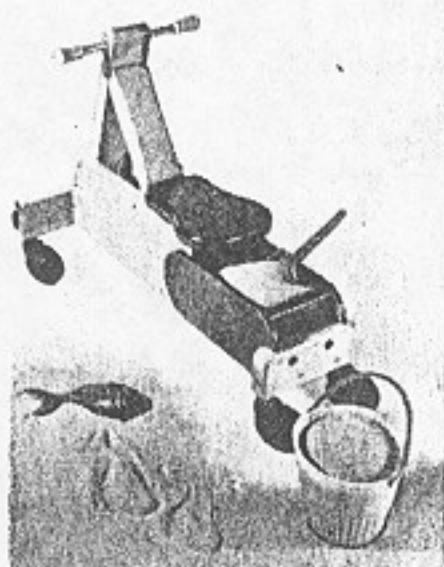
Bob Johnson, Lakewood, N.J.

1 ASSEMBLE THE FRAME FIRST, carefully sawing the angles shown in the drawing. Drill a $\frac{5}{8}$ " hole to take the handle.

2 NAIL ON THE SIDES, which hold the seat, drill front and back for axle-tree bolts, and nail the back from below.

3 SIDE PANELS reinforcing the back are held by 4-penny nails (all others are 6-penny). Resin-coated nails hold best.

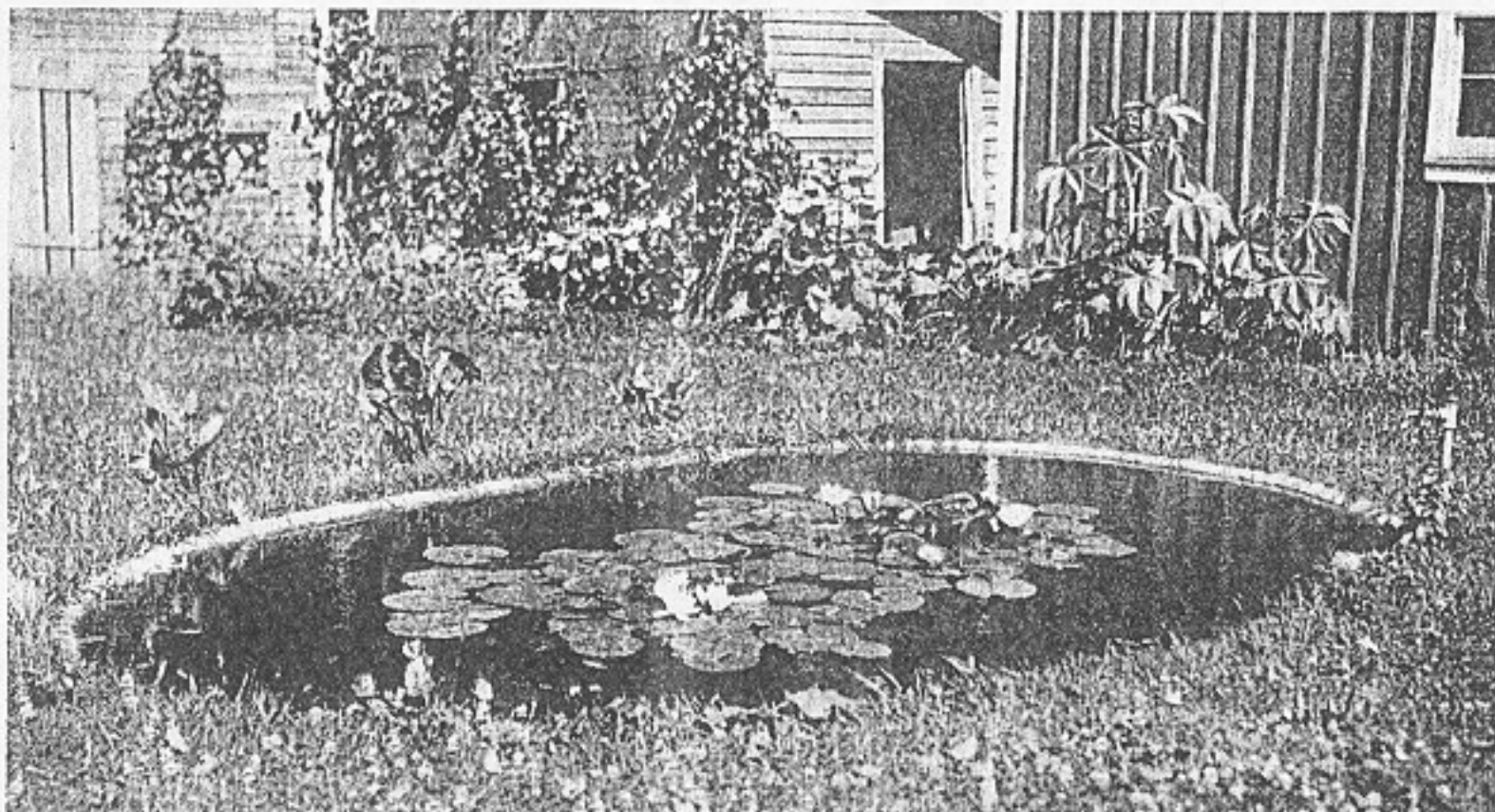




4 IT'LL BE A FAVORITE —with first-steppers or five-year-olds. It hauls dolly around in the house—or a play load of sand outside.



MAKING MONEY with CONCRETE PROJECTS



This backyard pool, which can be built by anyone for less than \$5.00, is a real money-maker for its owner. He has planted water lilies in the center to supply oxygen for the goldfish with which he has stocked the pool, and although he lives on a farm 20 miles from a town, he has more customers for his goldfish than he can take care of.

THE MECHANICAL PACKAGE MAGAZINE

1932

by E. S. McGOWAN

IN these days of depression when most all of us are looking for ways to turn an honest penny, there is one field of profitable activity which should appeal to the home craftsman, but which has been unaccountably neglected, probably because of lack of specific information.

I refer to the making of concrete lawn furniture—bird baths, lily pools, and similar additions to the garden landscape. Larger firms dealing in concrete products have neglected this business, leaving the field open to any ambitious worker who is willing to put in a little effort in exchange for coin of the realm.

Bird Baths are Money-Makers

Just as an example, take the popular concrete bird bath. The type shown in an accompanying photograph sells readily for \$10 to \$15, and it's no trick to erecting one in a day. The lily pool shown at the top of this page is equally simple, and has an additional profit-making angle other than its construction—it can be stocked with goldfish, which breed rapidly, the surplus being salable at good prices.

Construction of the bird bath is simplicity itself—here's how: Secure a hoop 3 inches wide and 24 inches in diameter, with one joint,

for the base form. For the font form, use the steel felloe of an auto wheel, available for a few cents from any wrecker. This will have one cut across it. Opposite this make another cut of V-form.

The pedestal may be round, square, or hexagonal. The drawing shows how to make the mold from wooden pieces hinged together. Sketches also make clear the construction of the base and use of stove pipe as a core in the pedestal to lighten weight.

Set the pallet firmly and center the base form on it, placing a wire tightly around it and twisting the ends together. Place at least four nailing blocks to hold it. Place the core in position and fill the form with concrete, set steel rods for reinforcing and trowel the surface smooth. Place the assembled form for the shaft. Fill the shaft form with concrete in layers about 5 inches thick, "puddling" it well with a planed lath. When full strike off top and finish with a trowel.

The font is made upside down on the same or a similar pallet using a steel form or shaped clay for a core to produce the depression. Center the outside form, bind it with a wire and place four nailing blocks. Place the concrete, strike it off and finish with a trowel.

Consider the fact that this article was written 63 years ago and realize the prices have gone up. Just upscale your prices. At any rate, this is a complete course and could put any able-bodied person into a business of his own and at a very low overhead. There are also many concrete projects in SURVIVOR 1.

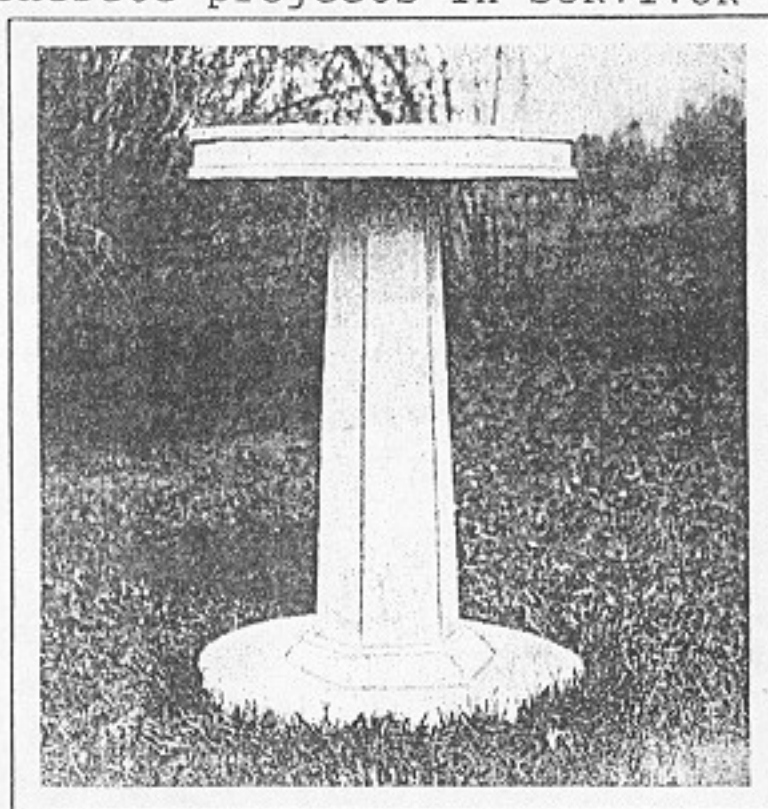
Wood forms should have two good coats of spar varnish before being used.

Before assembling forms oil them thoroughly but lightly with a brush dipped in paraffin oil such as is used for floors. This keeps the concrete from sticking. After 24 hours the forms may be stripped and should be immediately cleaned and re-oiled. The cast concrete parts should be covered with damp burlap and kept very wet for four or five days. Portland cement sets by the action of water and after setting hardens and if it is allowed to dry out it will be weak.

Other Lawn Furniture

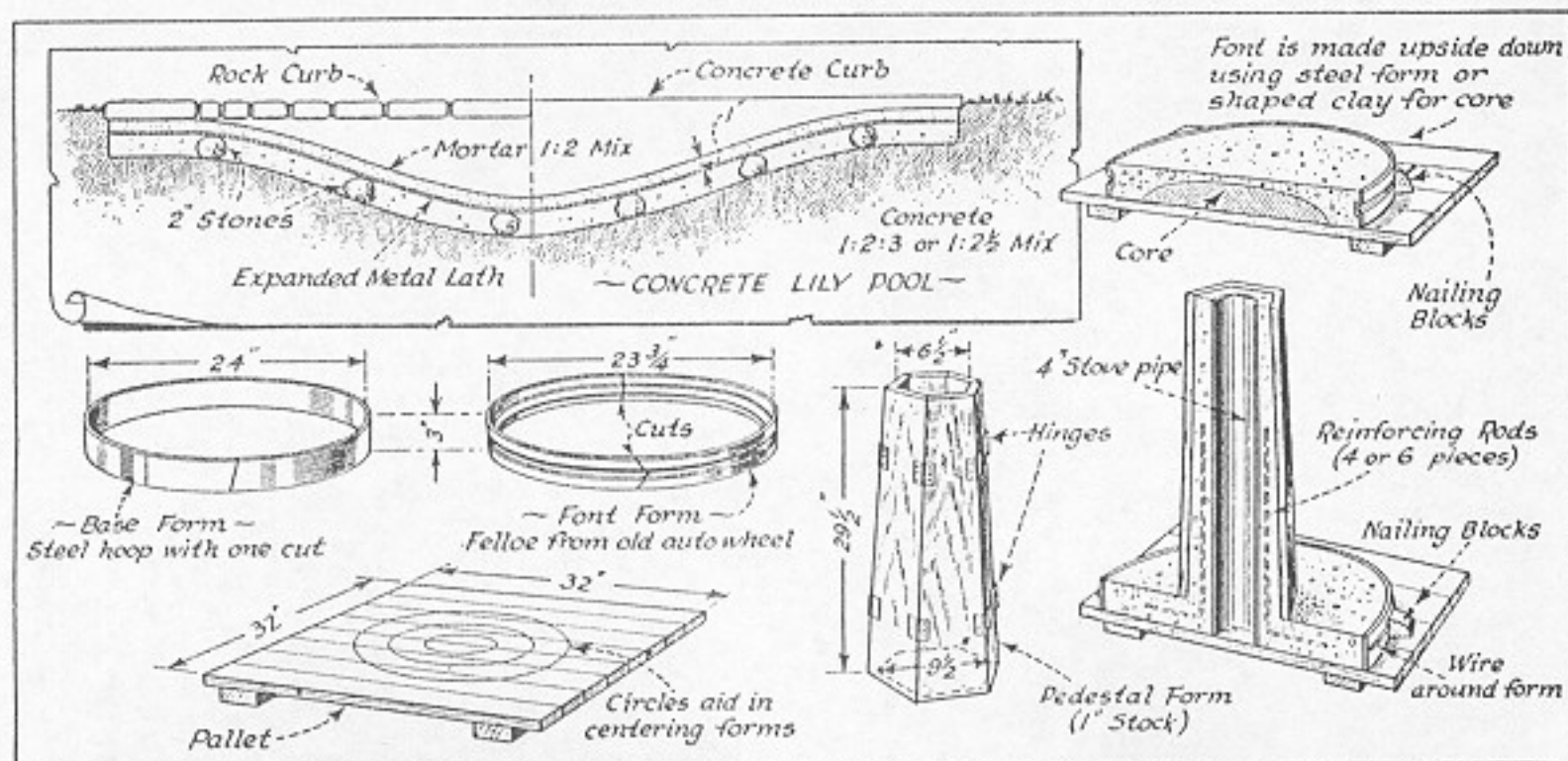
There is practically no end to the possibilities in lawn furniture, for in addition to bird baths, forms for lawn benches are easily made as also are stands for sun-dials, flower pots, from small ones a foot square at the top, 10 inches high and 9 inches square at the bottom, to larger ones to hold small evergreens or "English box." A variation in dimensions will produce a flower box, a good size being 30 to 40 inches long, 9 inches or a foot wide on top and 6 to 8 inches wide across the base. These pots and flower boxes should have walls about $1\frac{1}{2}$ inches thick.

The forms are made of inch stuff (pine will warp less than other wood) and preferably should be arranged so that the product is made right side up, which allows of finishing the top edge with a trowel or other finishing tool to give a neat appearance. For ornamental pur-



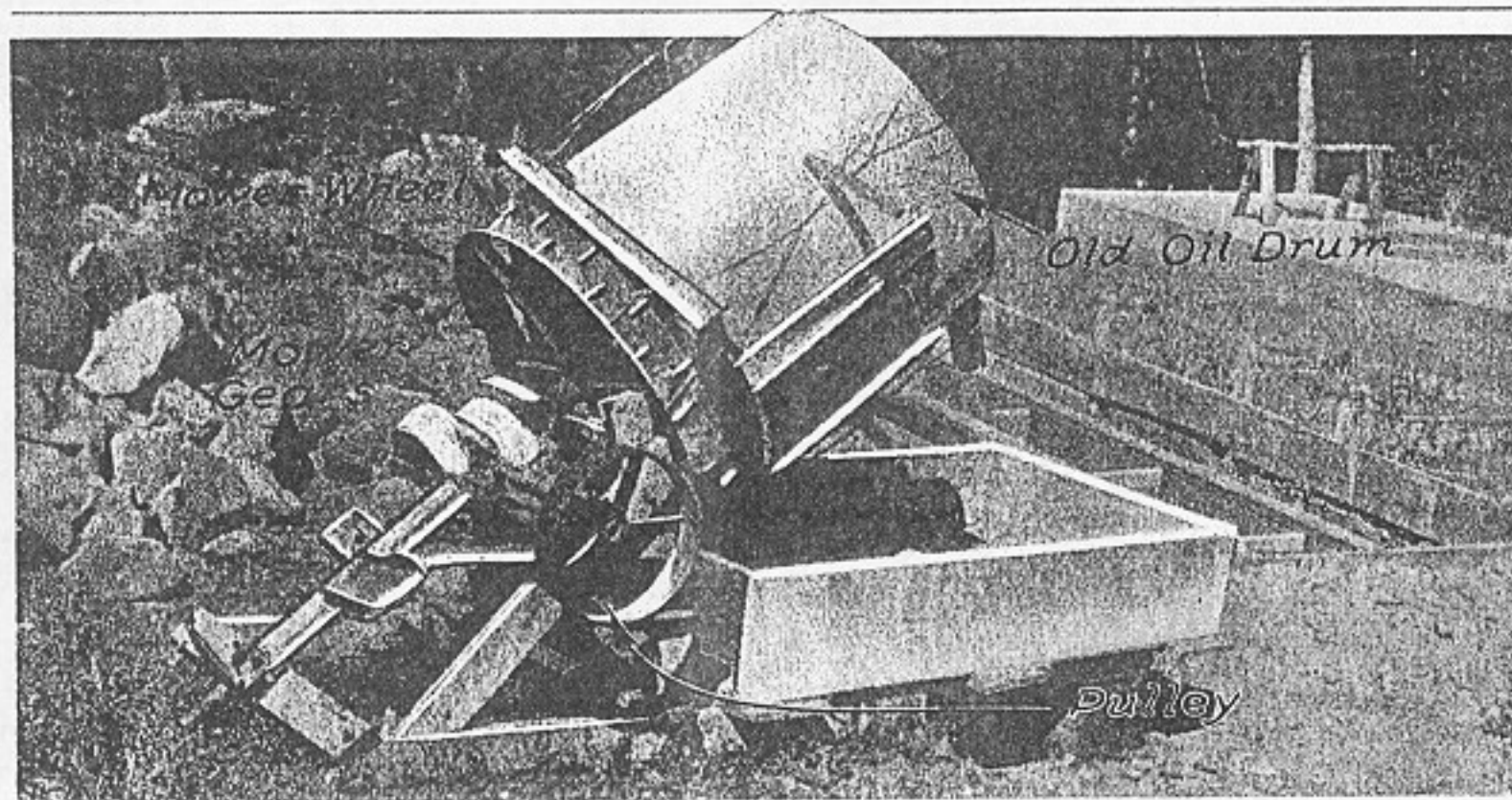
Concrete bird baths like this easily bring from \$10 to \$15 from home-owners. An enterprising builder can make a handsome profit from the sale of baths described below.

poses, if other than plain surfaces are desired, pieces of wood are attached to the inner surface of the outside form to produce depressed panels and pieces of moulding may also be used to produce ornamental details.



Here are construction details of a concrete lily pool and of a typical pedestal bird bath. Further pointers on building are given in the article. Concrete lawn furniture is very popular, yet most large firms neglect the possibilities in this field, leaving excellent money-making opportunities open to the "one man" producer. Every home-owner is a prospect. This article gives all the information you need to go into business for yourself.

GOOD CONCRETE MIXER FROM OLD MOWER PARTS



Any ingenious mechanic can construct a mechanical concrete mixer from scrap parts, as witness this example made from the axle of an old mower. A pulley is attached to the driveshaft, an oil drum from which the top is removed is bolted to the mower wheel, and the device is driven by a portable gas engine and it does the trick!

So far as artistic effects are concerned there is no limit except the ingenuity and craftsmanship of the worker.

Round vases are made by setting a piece of pipe vertically in the center of a sturdy pallet, heaping wet clay around it and forming this to the opening desired with a piece of heavy sheet metal cut to the necessary shape, one edge being bent around the pipe on which it revolves. Cement and sand mixed only moderately wet is then placed over the core and the exterior shape formed with another sheet metal form cut to the profile of the exterior of the urn. Some practice is necessary for success with this method, but by starting with a small urn skill will be quickly gained and the results attained will well repay the effort put forth.

Now for the lily pond and goldfish farm. A pool 10 feet long and 6 feet wide will require about three sacks of cement and a yard of gravel; total cost should not be over \$5.

Building the Pool

Lay out the pool and excavate to the desired depth. Pack down the earth by tamping. Place stones about two inches in diameter some 18 inches apart, to gauge the thickness of the first course of concrete. If you have screened sand and pebbles, make your mix of one bucket of cement, two of sand and three of pebbles. If using gravel as it comes from the pit, mix one to 2½. Mix thoroughly while dry; then add water and mix again. Consistency should

be like oatmeal porridge—"quaky," but not so wet that water and cement runs from it when piled up.

Place the first course to make an even thickness to the top of the two-inch stones. Without smoothing it, cover with hog fencing or metal lath for reinforcement, and follow this with a one-inch layer mixed one part cement to two parts sand. This can be smoothed with a trowel and let set for 12 hours. Then fill the pool with water, let stand a day or two, empty and refill. It should have three changes of water at least before plants or fish are placed in it.

The owner of the goldfish breeding pool illustrated here does a big business with his neighbors, having more orders than he can fill. Pond lilies are grown to supply oxygen to the water for the fish. Be sure to give your fish plenty to eat, since they're cannibalistic and papa and mamma are just as likely as not to eat their babies if hungry. Special fish foods are obtainable, but rolled oats has been found highly satisfactory.

Mixing Good Concrete

A few general pointers on good concrete work are in order. The most pertinent fact to remember is that the strength and watertightness of concrete depends on the amount of water used in mixing it. Good concrete can be neither too dry nor too wet. One of the accompanying diagrams illustrates the "slump test." Study the drawing. A good mix should

show a slump of at least a half-inch, and should not be so wet as to cause a separation of the particles in handling and placing.

An accompanying table gives a list of classes of work, with amounts of water to be used with sand and pebbles. Moisture in the sand must be considered. Under "trial mixture" are given proportions for a trial batch. If it proves too wet, add more sand, and if still too wet, more pebbles and perhaps more sand. The quantity of pebbles should always be about twice the quantity of sand. If the mix is too dry, add more cement and water, but not water alone.

Under "maximum aggregate size" is given the size of the largest pebbles which should be used.

The sand should be clean and hard and free from loam and clay and vegetable matter. These foreign materials will prevent bonding between the cement and sand and the concrete will be weak. Vegetable matter will interfere with the setting and hardening of the cement. Concrete made with dirty sand will harden very slowly if at all and often will not be hard enough for its intended purpose.

Pebbles or crushed stone should be tough, rather hard and free from foreign matter. If either contains considerable soft, flat or elongated particles it should not be used.

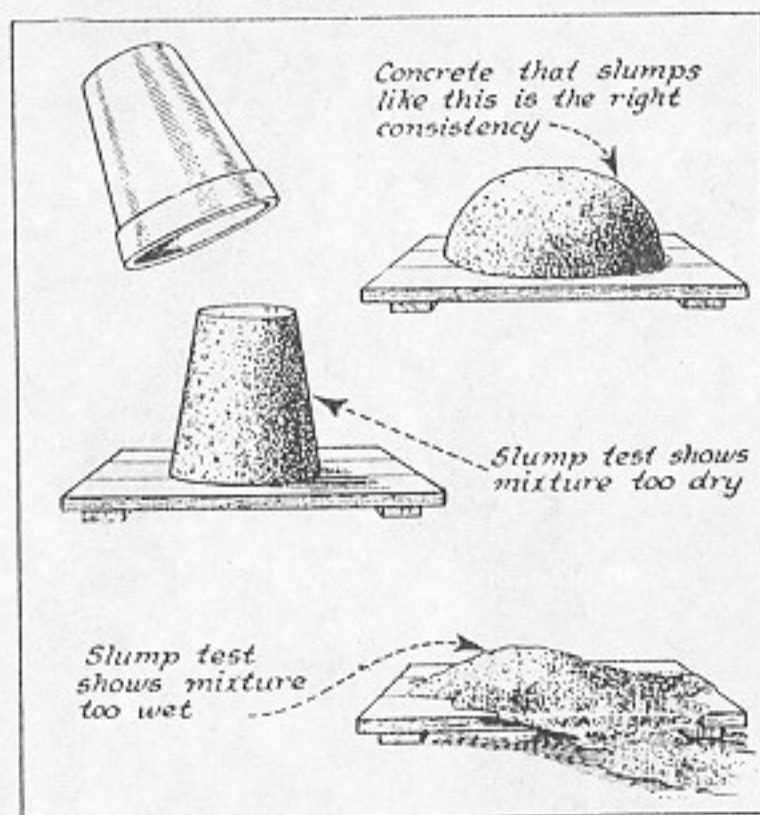
"Bank-run" gravel is the natural mixture of sand and pebbles as it comes from a gravel bank. It nearly always contains too much sand and money will be saved by screening the sand from the pebbles with a $\frac{1}{4}$ -inch screen and recombining in the proportions you want.

Water for concrete should be fit to drink.

Machine mixing is the best and the easiest, better let a gas engine do the hard work if you can. Many an ingenious man has built a mixer from old machinery — one excellent home-made job it illustrated in these pages.

If the concrete must be mixed by

SLUMP TEST FOR MIXTURES



Good concrete should "slump" or spread out, just after mixing, as shown in the top drawing, when emptied on board from a bucket. Other mixes are too dry or too wet.

hand and a tight floor is not available, make a watertight platform with strong and smooth

lumber. It should be large enough for two men to work on at once; about 7 feet wide and 12 feet long is a good size. If the top is made of matched lumber the joints will be tight. Nail strips 2 to 4 inches high along three sides to prevent materials being pushed off in mixing.

Hand Mixing

Place one of the bottomless boxes on the platform and measure the quantity of sand to be used. Spread this out evenly and on it spread the quantity of cement to be used. Then turn these over, using a square ended

RECOMMENDED MIXTURES FOR SMALL JOBS

Kind of Work	Gallons of Water to Add to Each One Sack Batch			Trial Mixture For First Batch			Maximum Aggregate Size
	Dry Sand and Pebbles	Moist Sand and Pebbles	Wet Sand and Pebbles	Cement	Sand	Pebbles	
Foundation walls which need not be watertight, mass concrete for footings, retaining walls, etc.	7½	6	5	1	3	5	2
Watertight basement walls and pits, walls above ground, dams, hot beds, cold frames, storage and cyclone cellar walls, etc.	6½	5	4¼	1	2½	3½	1½
Water storage tanks, well curbs and platforms, cisterns, septic tanks, watertight floors, sidewalks, driveways, porch floors, basement floors, garden and lawn pools, steps, gate posts, piers, columns, chimney caps.	5½	4¼	3¾	1	2	3	1
Fence posts, clothes line posts, grape arbor posts, mail box posts, etc., flower boxes and pots, benches, bird baths, pedestals and other garden furniture, work of very thin sections.	4½	3¾	3½	1	2	2	¾

shovel, the two men working from opposite sides and ends. Continue mixing until the mass is of a uniform color and free from streaks showing the colors of the sand and cement.

The required amount of pebbles is then measured and spread in a layer on top of the sand-cement mixture. Mix again until the pebbles are uniformly distributed throughout the mass. Now make a round pile and dig out the center to make a crater into which the correct amount of water is poured. Start from the edge of the crater with the shovel upside down and push the dry materials toward the center until the water has been taken

up. Then continue mixing until the cement, sand and pebbles are thoroughly and uniformly combined. The final shovelling should bring the mass to the form of a mound.

All the concrete should be placed in the forms within 30 minutes after mixing. As it is placed in the forms it should be well tamped or spaded, paying attention to getting it to fill all parts of the forms, especially the corners. If exposed parts are desired to be smooth, spade the coarse particles back from the forms so that the sand and cement will produce smooth face.

AMERICAN COOKERY June-July 1932

QUERY No. 4994. — "I am planning a dinner where it is estimated that One Hundred Pounds of Meat or Fish will be needed to serve all who are expected to attend. How Much Meat or Fish Should Be Bought to Yield One Hundred Pounds When Cooked?"

How Much Meat or Fish Should Be Bought to Yield One Hundred Pounds When Cooked

This will depend on the kind of meat or fish you buy. Fish of moderate size will have more waste in bone, etc., than large fish, like halibut. And as for the meat, it depends on what joints of the animal you buy how much waste in fat and bone you will have. Clear, edible meat may be expected to lose from 20 to 25 per cent during cooking, through shrinkage and loss of juices. As for proportions of fat and bone, these vary from 7 per cent in a round to 20 per cent in a rib roast, according to Atwater's tables published in the government bulletins.

We think you would do well to consult an experienced chef in a good hotel, who is used to catering for large companies.

QUERY No. 4995. — "I greatly desire a good recipe for Hollandaise Sauce. The kind most frequently served to me is thin, runny, and poor."

Hollandaise Sauce

We are particularly glad to answer your query, since we too have suffered from a wretched travesty of this fine sauce, and very rarely do we get it at its best. Here is

the best recipe we know for hollandaise sauce, and it will pay you to follow it exactly.

Put into a quart bowl with a rounded bottom one-half a cup of softened butter, and beat it until white and creamy. Add, one by one, the yolks of four raw eggs (we sometimes substitute two whole raw eggs with excellent results), and beat each until it is blended with the butter before you add the next. Then add a tablespoonful and one-half of lemon juice, one-half a teaspoonful of salt and just a wee pinch of cayenne, and beat again until smooth. So far the beating has been done with the spoon used to cream the butter, but it is now time to make a change. Remove this spoon (of course returning to the bowl all that has stuck to it) and with a Dover beater beat the butter, eggs, lemon juice, etc., for five minutes. Then stand the bowl in a pan of boiling water over the fire, being careful not to let the water boil into the bowl, add to its contents one-third of a cup of boiling water, and beat constantly and all over until the sauce is as thick as a thick mayonnaise, so thick it will "horn." Now lift the bowl from the boiling water, and stand it for a moment in cold water, while you beat or stir from the sides any of the sauce that may be in danger of being overcooked by the retained heat of the bowl. This last precautionary operation will take no more than half a minute, and now your sauce is ready to serve, thick, glossy, most delicious.

This cradle rocks and rocks

An "old-fashioned" cradle, one that would rock and lull the baby, was the desire of Mr. and Mrs. Hans von Briesen, San Francisco. They wanted one that would be sturdy, yet light enough to be moved about, and high enough for them to attend to the youngster without stooping. When they couldn't find such a cradle anywhere, a friend designed and built this handsome modern version for them. He assembled it almost entirely with screws, so that the cradle could be disassembled and packed for a long move the von Briesens expected to make in a few months. This feature proved of additional value. A rocking cradle is delightful to have during those first few months, but it is impractical after the baby learns to crawl. Disassembled, it stores away compactly.

All wood parts of this cradle were cut from $\frac{3}{4}$ -inch Philippine mahogany plywood. The exposed edges of the plywood were covered with mahogany edge striping, purchased at a lumber yard and glued on with contact cement.

You can draw the curves with a compass or with a pencil and a length of string. The curved parts can be cut out with a jigsaw, band saw, scroll saw, or router.

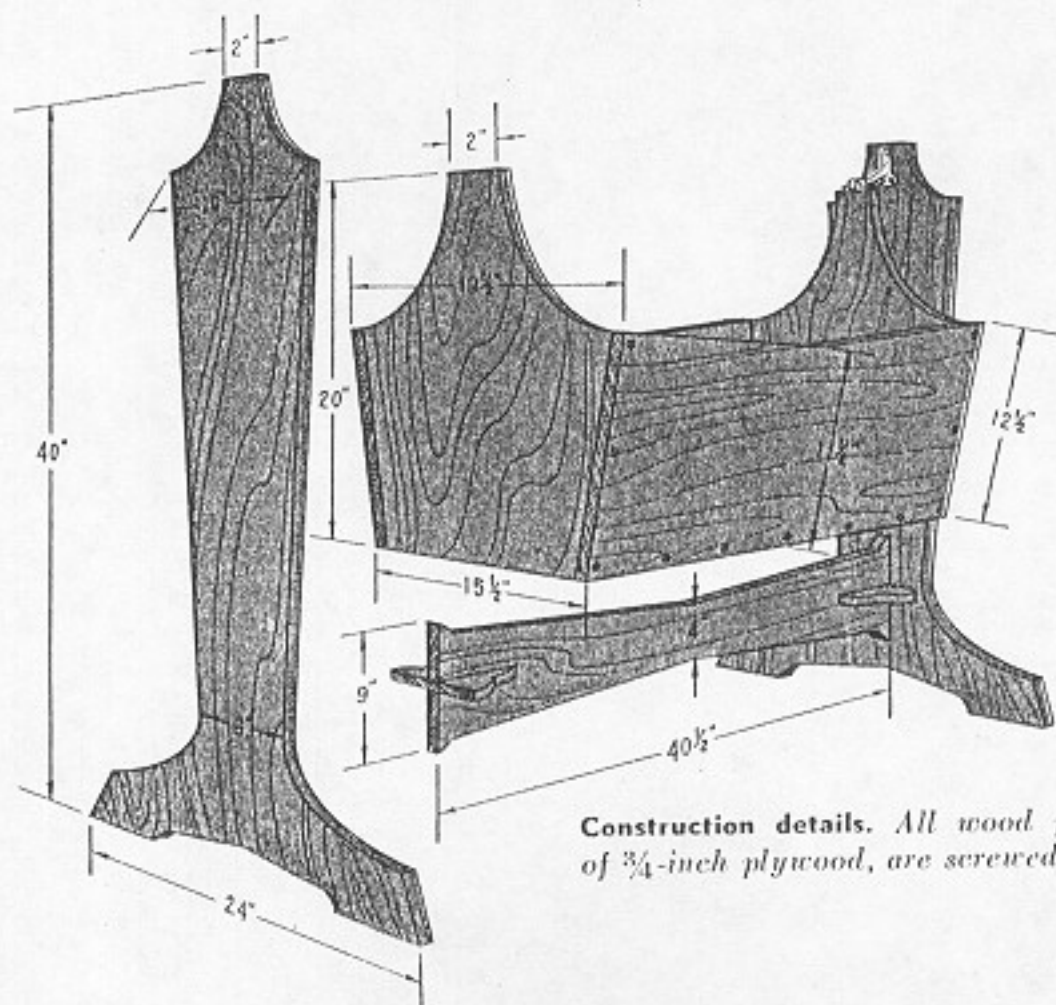


The baby likes the gentle rocking motion of this cradle. The designer: Gordon Brofft

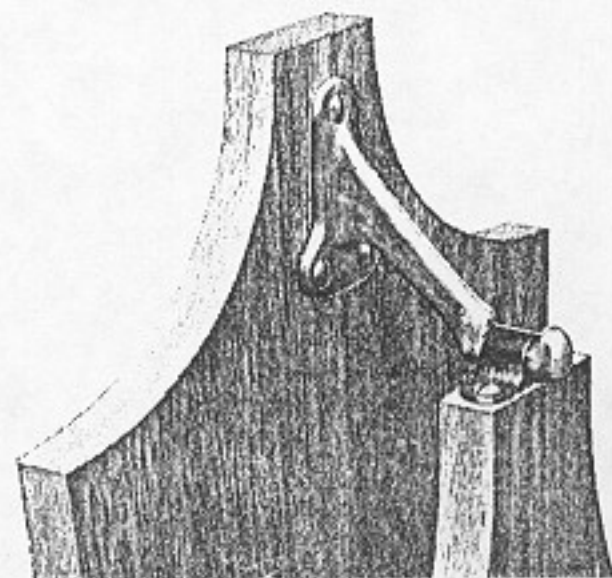
Sunset March, 1962

The single cross piece is notched at its ends for its small reinforcing blocks, which are glued permanently to it; then all are screwed to the wood ends.

The cradle swings on its end supports on two metal stair-rail brackets (available at builders hardware stores). The brackets are screwed upside down to the end supports, and the two small straps (which come with the brackets) are secured to the top edges of the cradle with 3-inch-long wood screws.



Construction details. All wood parts are of $\frac{3}{4}$ -inch plywood, are screwed together



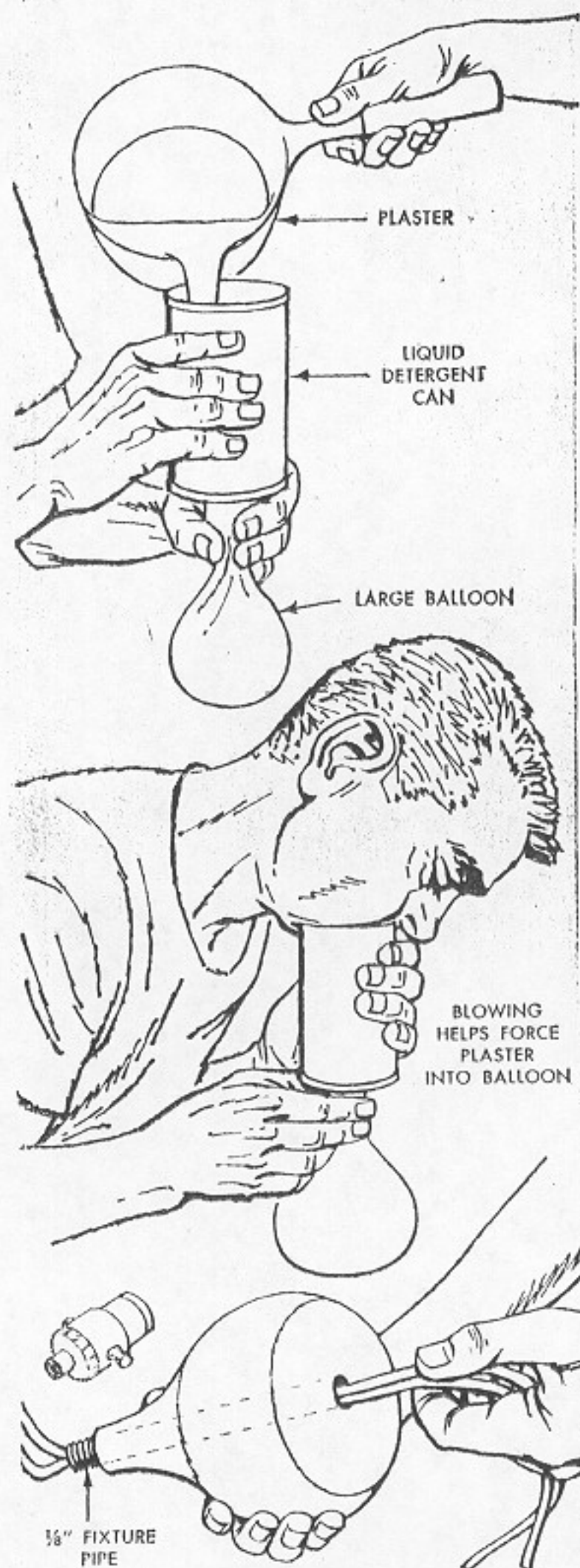
Cradle rocks on two stair-rail brackets, which are attached upside down to ends

CASTING PLASTER

Popular Mechanics February 1950

By Howell M. Burke

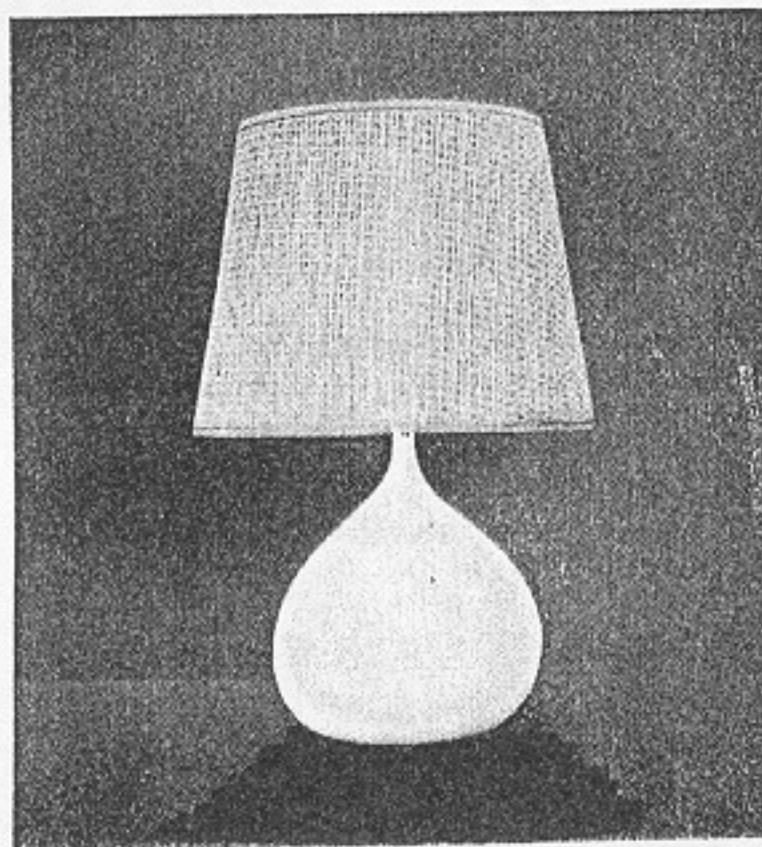
BALLOON LAMP BASE



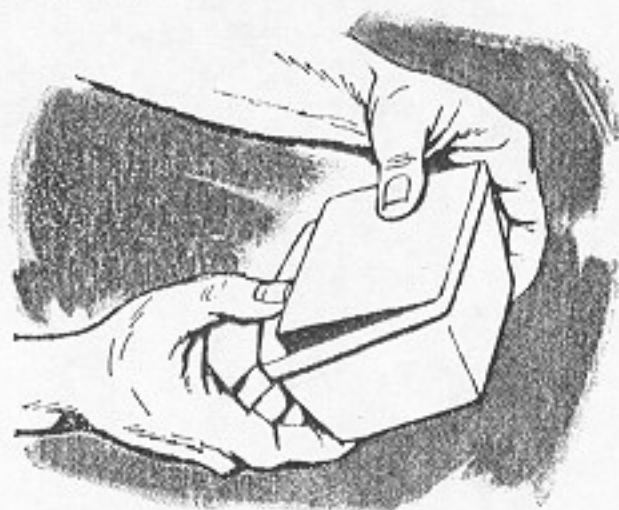
SPECIAL-OCCASION gifts must be simple, useful and decorator styled. These requirements immediately suggest a lamp, planter or perhaps ash trays, all designed and handcrafted with just a touch of flair. The lamp bases and planters pictured below and on the opposite page are selected examples of what you can do with the simplest equipment, most of which you may already have at hand.

All the items pictured are plaster castings, made with what is known to the trade as molding plaster. The lamp base below is made with plaster, a detergent container and a large toy balloon. The essential three steps in the casting procedure are shown in the details at the left. First, cut the bottom out of the detergent can and unscrew the cap. Then attach the balloon to the neck of the can, using a length of fine wire, or better still, a pipe cleaner, which can be twisted tightly, yet is easily loosened quickly. Fill the balloon with water, then empty into a container. The amount of water contained in the balloon will give a measure of the amount of plaster you will need to mix.

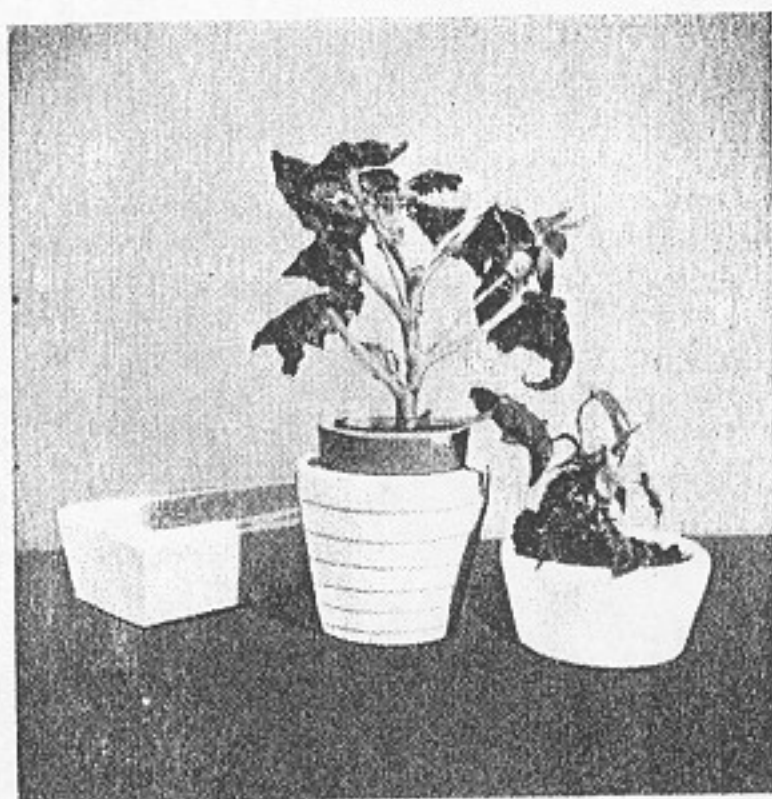
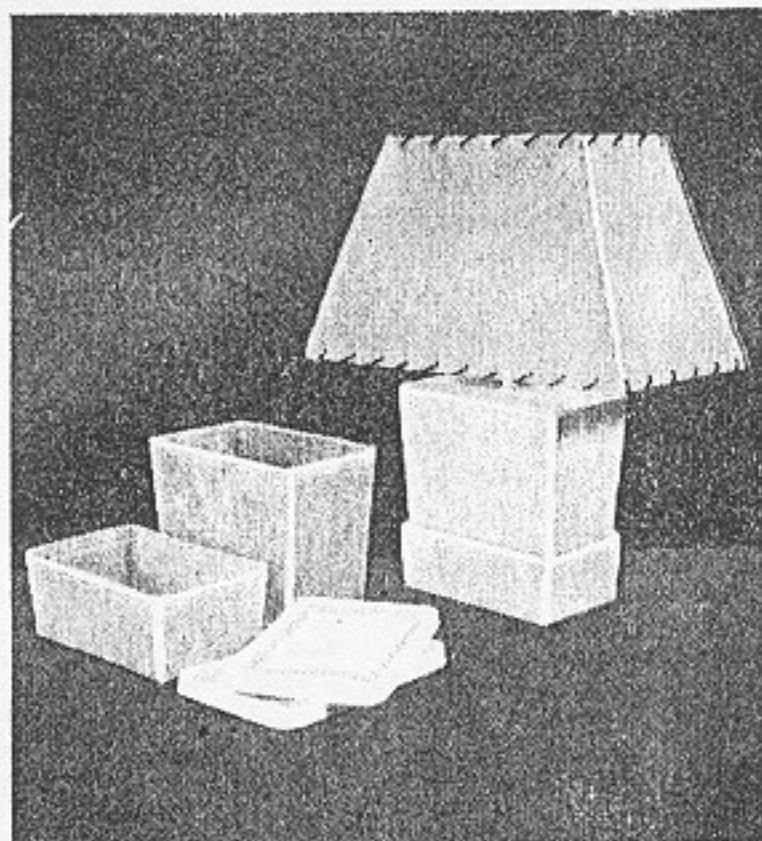
With everything in readiness at the kitchen sink or laundry tubs, including a length of $\frac{1}{8}$ -in. threaded fixture pipe, mix the plaster in a large shallow pan with a pouring lip. For best results the mix should be about the consistency of heavy cream so that it will pour easily. At this point it will facilitate the procedure if you have



GIFTS



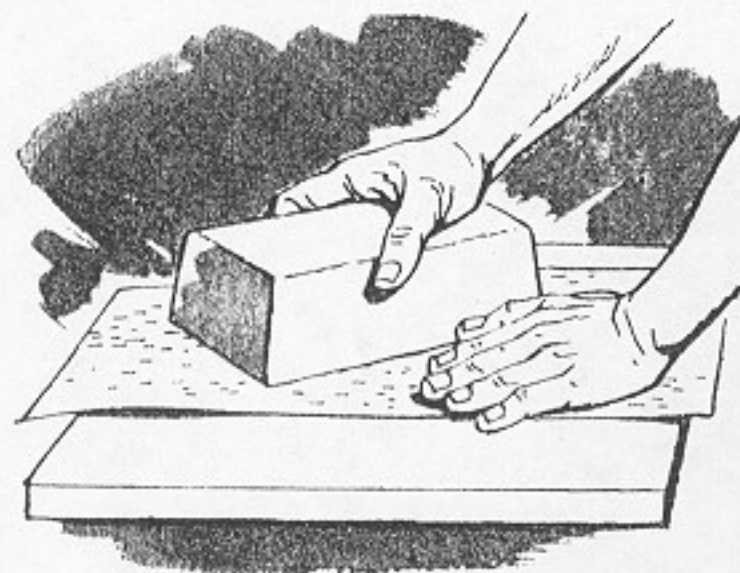
Use care when working casting out of plastic mold. Plaster should be fully hardened before removal

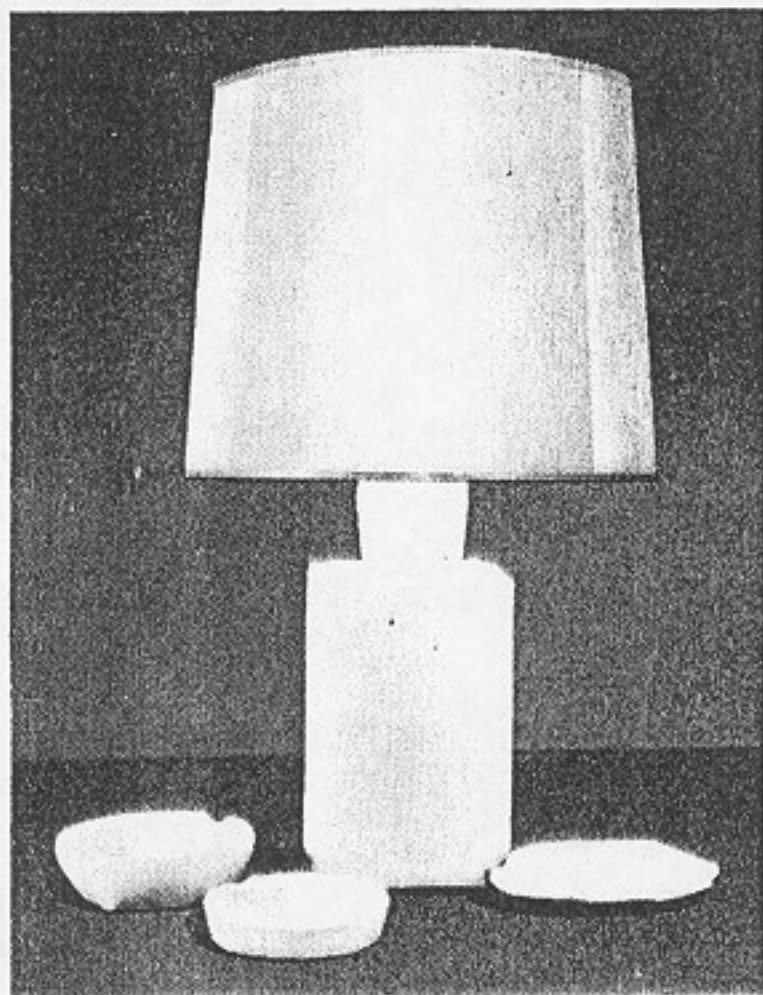


Above, planters of various sizes make useful gifts. Below, mixed plaster should be poured into mold without delay. Right, after casting has been removed from mold, smooth by rubbing on coarse sandpaper

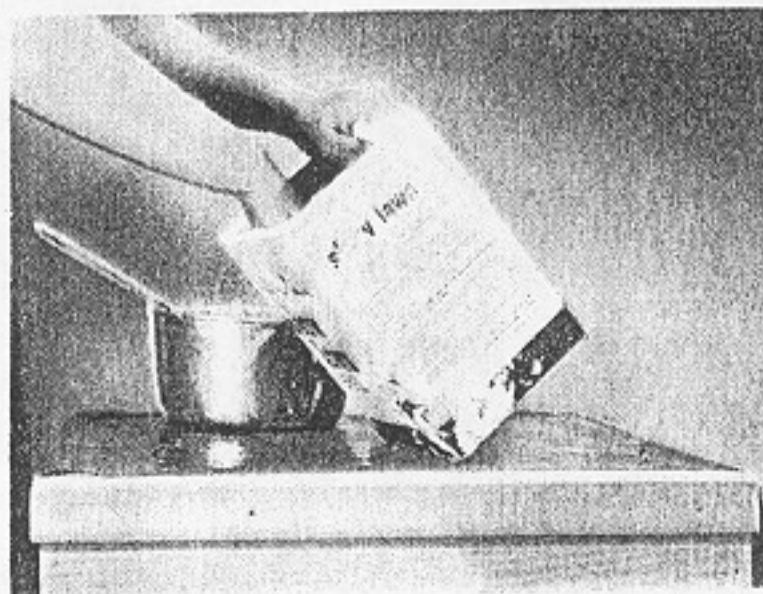
someone to help you. Molding plaster sets quickly and once mixed to a uniform consistency without any lumps, it must be used immediately. Squeeze the balloon lightly with one hand to force out the air it may contain and have your helper pour about one third of the plaster into the can. Without delay, blow lightly into the can as in the center detail on the opposite page. This will force the plaster into the balloon. Repeat this procedure as rapidly as possible until the balloon is full.

Now remove the filled balloon from the detergent can and place it on a flat surface. Allow the casting to spread somewhat so that it takes the bulbous form pictured. The bottom will flatten and for this reason it's important to hold the cast in the perpendicular position. Next, working quickly, open the balloon carefully and insert the threaded pipe, one end of which has been plugged with a dowel, into the neck of the cast and push down to the bottom. Make sure that the pipe stands perpendicular to the surface on which the cast is placed. Now, working lightly with the tips of the

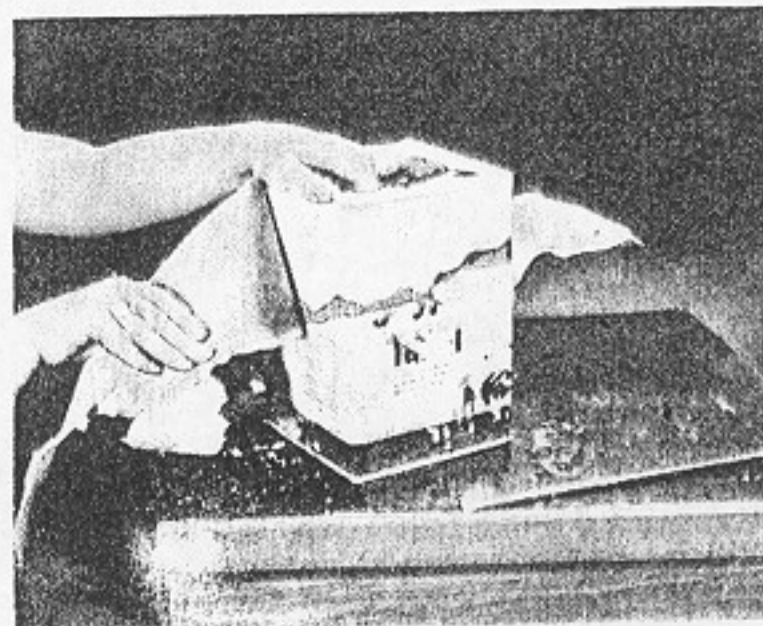




Rectangular lamp bases and ash trays are easily made by using cardboard boxes or utensils as molds



Above, "hand-trowel" the plaster into cardboard-box mold. Below, when plaster has set, strip off box. Right, smooth top of casting with file and sandpaper



fingers, form the neck of the cast around the threaded pipe, shaping to a true curve and uniform diameter.

As soon as the pouring is finished, have your helper wash the utensils and the sink or laundry tubs thoroughly. Do not permit even a small quantity of mixed plaster to enter the drain from the sink or tubs, as a residue may be left to harden in the trap, even though the drain is flushed with a quantity of water.

When the plaster cast has set, tear off the balloon and force the dowel plug out of the threaded pipe. Form a groove in the plaster casting from the outer edge of the flat bottom to the threaded pipe, using a round file. This groove permits the lamp cord to be led out at the side of the base. To finish up the job, wire a socket, slip a brass spacing neck over the threaded pipe, fit a harp and the socket, add a shade of your choice and there you are. By sizing the plaster casting you can decorate it with colored cutouts, or paint it in any color and pattern that suits your fancy. Cement $\frac{1}{8}$ -in. felt to the bottom of the base.

Using various types of plastic containers, bread tins, even a cardboard box which originally contained grass seed, you can make the lamp and planters pictured on page 183 and also the lamp base at the left. In making these the procedure differs somewhat from that used in making the balloon lamp base. You use a somewhat heavier and thicker plaster mix and press it onto the sides of the container with your hand, building up, by successive stages where necessary, until you have a thickness of $\frac{3}{4}$ in. or more. Wait until the plaster has hardened, then tear off the container and smooth the top edges of the casting with a file or by inverting and rubbing on a sheet of coarse sandpaper as in one of the illustrations.

An attractive planter can be made by using two bread tins, one small and one large one. Pour a creamy mix of plaster in the



larger and then press the smaller tin inside the larger one until the plaster is forced up to the top edge. Center the smaller tin and hold in position until the plaster sets. Then carefully remove the smaller tin and work the casting out of the larger one. Using the same procedure you can make round planters by using a child's plastic sand pail and a plastic juice container. Mix and pour the plaster in the large container as before and place the smaller one inside, pressing it down until the plaster is forced to the top of the pail. Hold in place until the plaster sets, then

remove the juice container and pail and smooth the edges of the casting. Finally, note the base of the lamp in the upper right-hand photo on page 183. This is made by using two separate containers of the type used to store leftovers in the refrigerator. Two separate castings are made and when the plaster has hardened a hole is centered through both to take the threaded pipe. Smooth the meeting faces of the two parts, then join tightly by running seating rings and nuts on the threaded pipe. By using containers of different sizes you get the attractive offset base pictured. ★ ★ ★

American Cookery

October, 1934

QUERY No. 5264. — "Is it possible for me to can tomato juice at home?"

Canning Tomato Juice at Home

So many have requested this same information that the Bureau of Home Economics has recently sent out the following information:

Equipment. The knives should be of stainless steel and the sieve of turned wire or aluminum. If you have cooking utensils of aluminum, use them. Utensils with heavily tinned surfaces or copper, brass and iron should not be used for preparing tomato juice as they affect the color and flavor.

Containers. The containers may be airtight glass jars, or bottles with caps. If caps are not available for bottles, corks may be used. Tin cans may be plain or enameled.

Preparation. Use any variety of tomato, although those of bright red color are preferred. Use only fully ripe, firm tomatoes as freshly picked from the vines as possible. Wash well, remove cores and cut in pieces. Some workers suggest that peeling gives a better-flavored juice. Green parts cause bitterness and mouldy or decayed portions influence both keeping quality and flavor. Do not try to make too much juice at once — not more than one or two gallons.

Storage. It is important to keep tomato juice in glass protected from light to preserve both color and flavor.

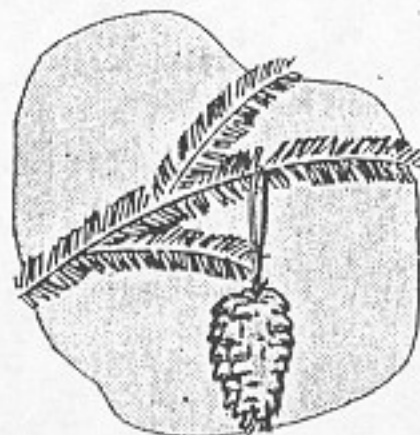
First Method. Simmer the tomatoes until they are softened. Put the hot tomatoes through a fine sieve at once. Reheat the juice to the boiling point at once, pour into sterilized containers, add one teaspoonful of salt to one quart of juice and seal.

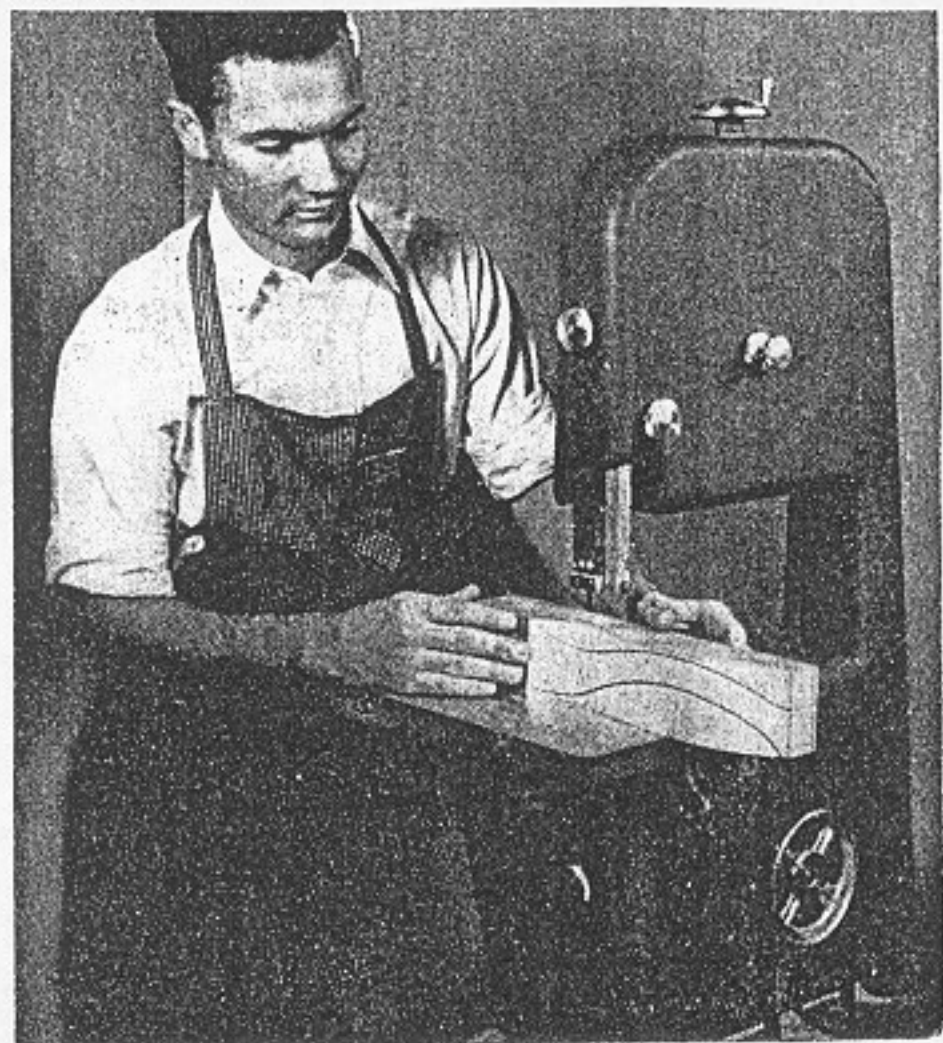
Newer Method. Cut the tomatoes into quarters, add a little water and heat to the simmering point. Press the tomatoes through a sieve. Heat the juice to the simmering point and pour it into hot, sterilized containers, almost to the top but not quite, as the heating may cause it to expand.

Seal the containers and set them in a hot-water bath that covers them and comes at least two inches above the top of the containers. Keep the water at the simmering point for ten minutes. Store.

Dry pine cones painted in gay colors provide beautiful Christmas-tree ornaments at little cost. Tied with ribbon and combined with holly, they also make attractive

table decorations for parties and novel window or wall ornaments for the holiday season. Dip the cones in silver or gold paint or brightly colored enamel and place on a piece of old window screen to dry.





THE HOME CRAFTSMAN JULY-AUGUST, 1949

THE band saw was invented in England about 1808, but it gave a good deal of trouble in the beginning. It was difficult at that time to make good bandsaw blades and even more difficult to hold the blades on the wheels because rubber linings and guides had not yet been devised.

Band saws are of various kinds: There is the band mill, which is the largest one, used for sawing logs into boards; the band resaw, also a large saw, used for sawing planks into boards; and the band scroll saw, used for sawing curved work, Fig. 1. Besides these band saws for sawing wood only, there are also band saws for sawing metal and band saws for sawing meat and bones.

The saw to be discussed is the band scroll saw, which is made in sizes from 9½" to 42". A band saw can cut as long or wide a piece as the diameter of the wheels, and the larger the wheels, the larger are all parts of the saw. We speak therefore of band saws as 36", 12", or 10" in capacity.

Large band saws are fastened to the floor; smaller ones, to a bench or a metal stand. The proper height of the table above the floor should be from 42" to 44".

A band saw consists of the following main parts: The wheels, the table, the guides and the guards as shown in Fig. 2.

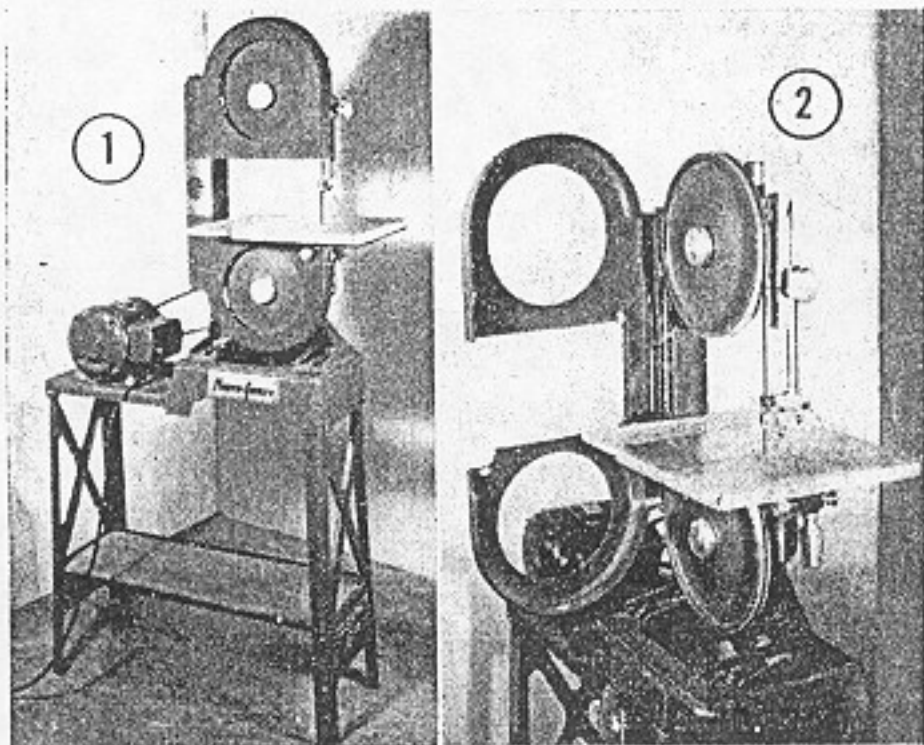
Ordinarily, a band saw has two wheels which are of the same size. They are mounted on the frame so that one is directly above the other one. The upper wheel is supported on an arm curving over the table, called a "gooseneck." The wheels are usually a casting and have rubber tires on their rims on which the bandsaw blade

THE BAND SAW

By HERMAN HJORTH

Author of *Operation of Common Woodworking Machines, Basic Woodworking Processes, Machine Woodworking, etc.*

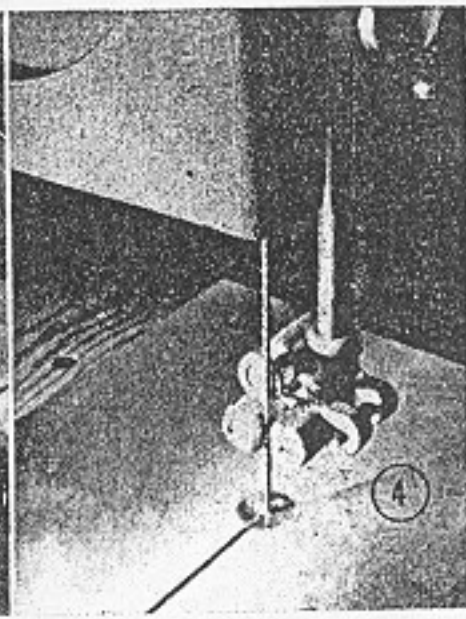
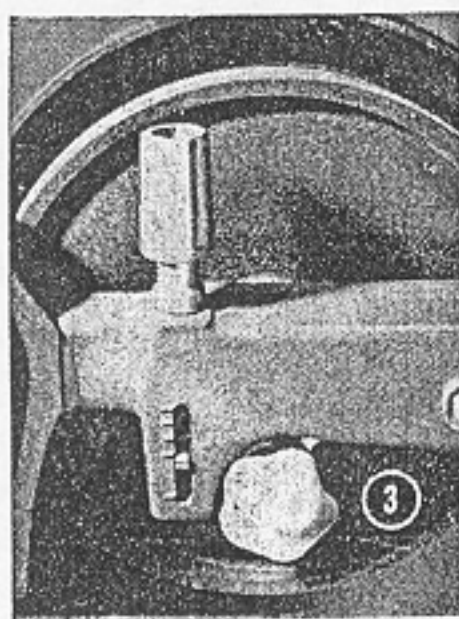
You can make your woodwork more professional by the expert use of the band saw . . . Its various parts and principal operations . . . Changing and adjusting blades . . . How to do compound and pattern sawing



Typical small band saw of the type used by home craftsmen. The view at right shows the guards swung back to reveal the rubber-cushioned wheels



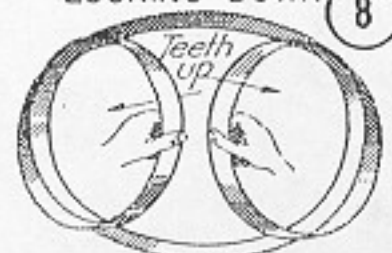
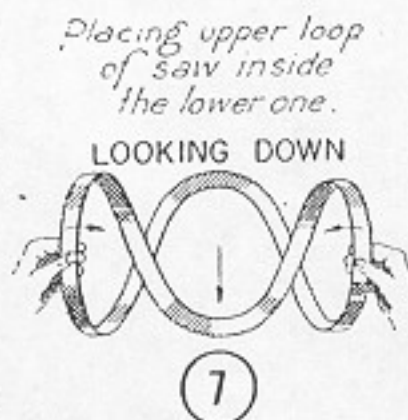
Holding band saw ready for coiling, teeth pointing away from body.



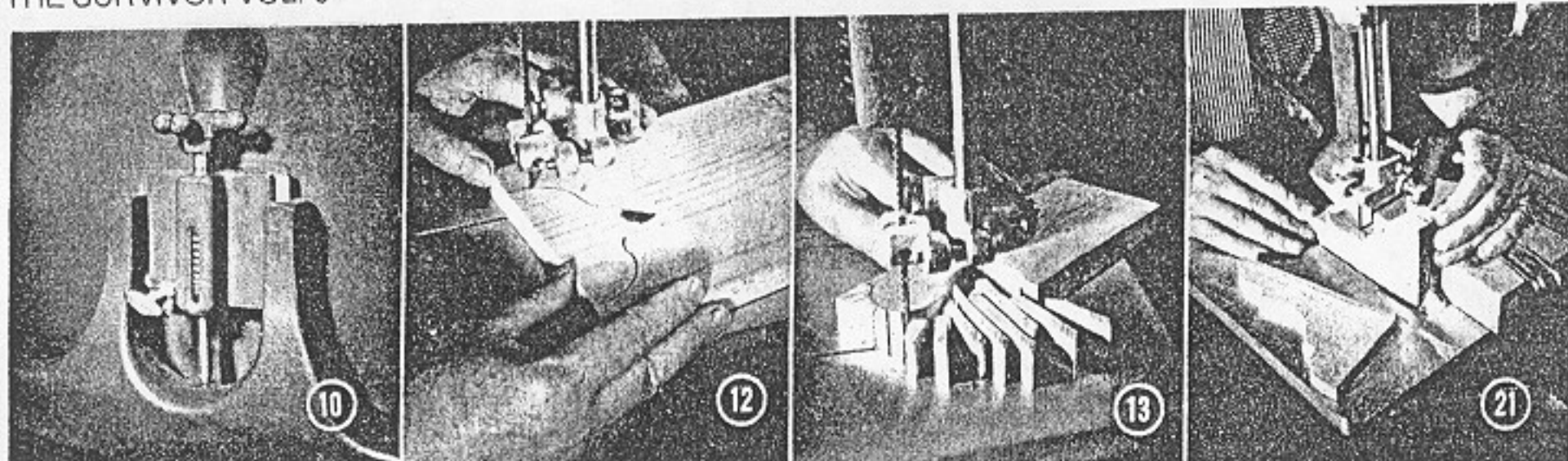
Blade tension is regulated by the adjustment shown at left, the scale being used for accurate reference. Right, blade guide on this band saw



Teeth bent out, upper loop of saw pointing toward floor.



Moving hands together, one crossing below the other, thus forming three loops.



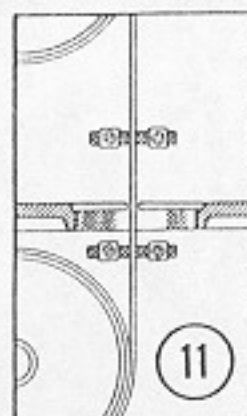
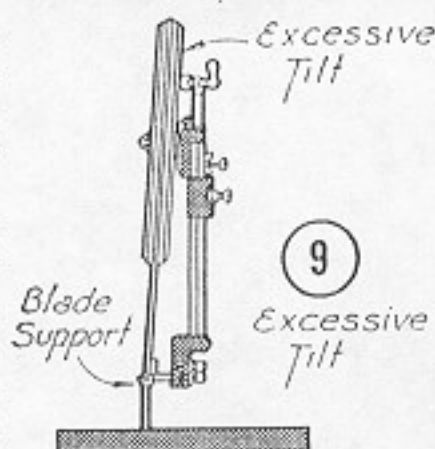
Combined tilt and tension adjustment on one type of band saw; cutting stock to a bored hole; the use of radial cuts in sawing small curves; multiple cutting in which a block is first sawed to shape, then divided into parts

runs. The rubber tires serve to protect the teeth, act as a cushion for the saw blade and prevent it from slipping.

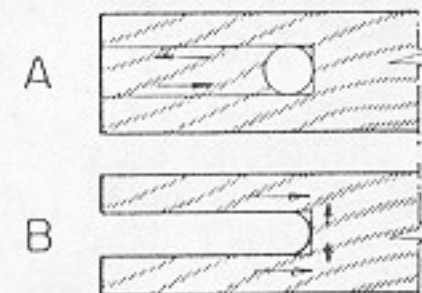
In case the blade breaks, the two ends can be filed to form a tapered or scarfed joint and soldered with silver solder. This, of course, makes the blade shorter. To accommodate short blades, the upper wheel can be lowered by means of a screw. The wheel also needs to be lowered and raised again so that a new or different blade can be put on the machine.

Some band saws have a tension mechanism that automatically gives the blade the correct tension, Fig. 3. On others the tension must be judged by pressing lightly on the side of the saw with the fingers.

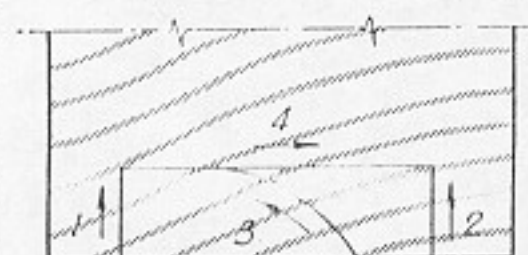
The table or tables are bolted to trunnions directly above the lower wheel. The larger machines always have two tables, of which the one to the left is the smaller and immovable one. The one to the right is the larger and can be tilted 45° to the right and about 10° to the left. The blade runs through a slot in the larger table, the entrance to which is cut from the front of the table. It has a steel pin



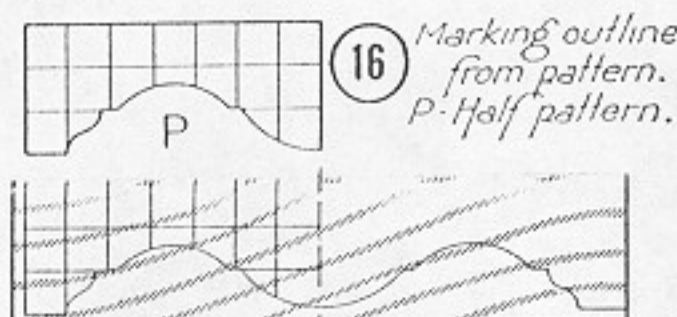
Guides in line



A - Hole bored in square corner
B - Sawing completed as indicated.



15 Sawing square corner.



16 Marking outline from pattern.
P - Half pattern.



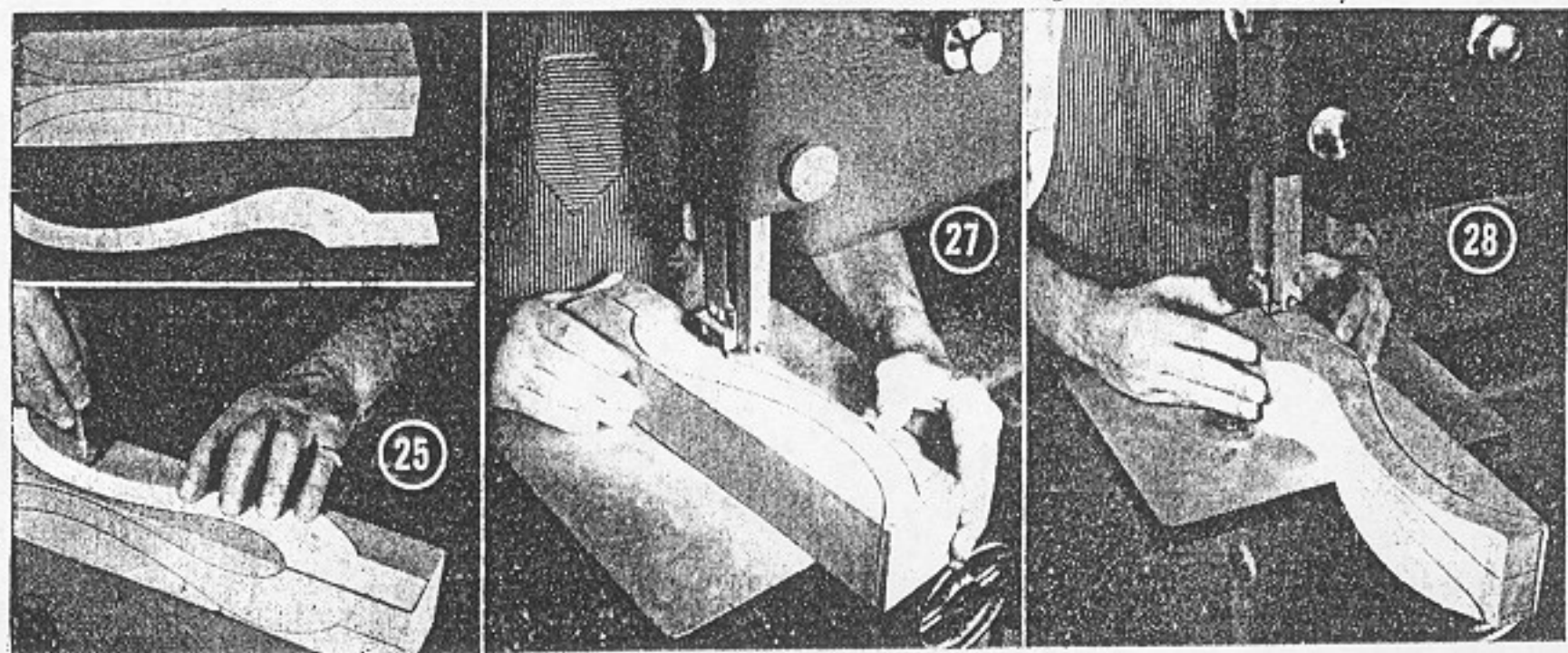
17 Suggested method of sawing irregular curve

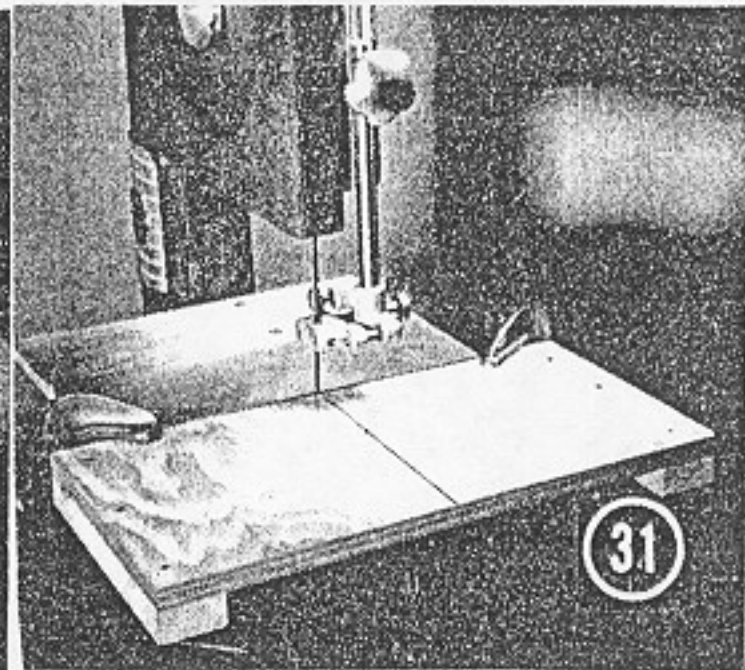
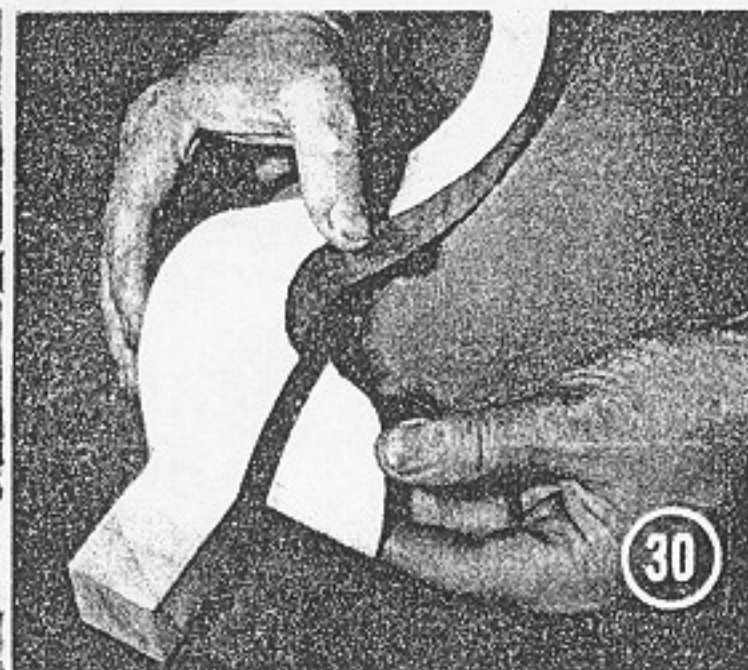


19 Multiple sawing, stock held in box.

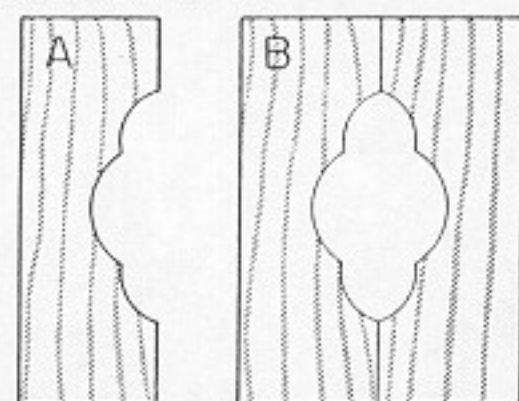
20 Multiple sawing, stock wedged together

How a cabriole leg is marked from a pattern. The first cuts are stopped just short of the end so that the waste wood remains attached. This enables remaining cuts to be made easily





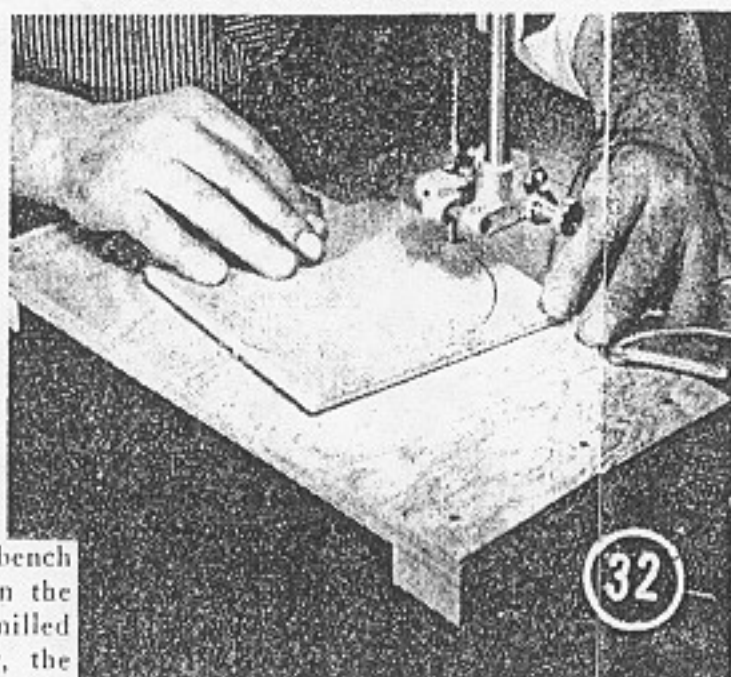
To save stock, the ears of a cabriole leg are cut separately and glued on. Figure 31 shows a jig attached to a bandsaw table for circle cutting. Disks are cut by pivoting the work on the point



18 Edges of both boards sawed as at "A". Boards glued together as at "B".

at the entrance. Some of the smaller bench machines have only one table, but on the other hand they often have a slot milled in it for a miter gauge. Moreover, the saw blade on the smaller machines often enters in a slot cut from the side. All saws usually have an aluminum throat plate so that the saw blade will not be damaged should it break.

The guides serve to keep the saw blade

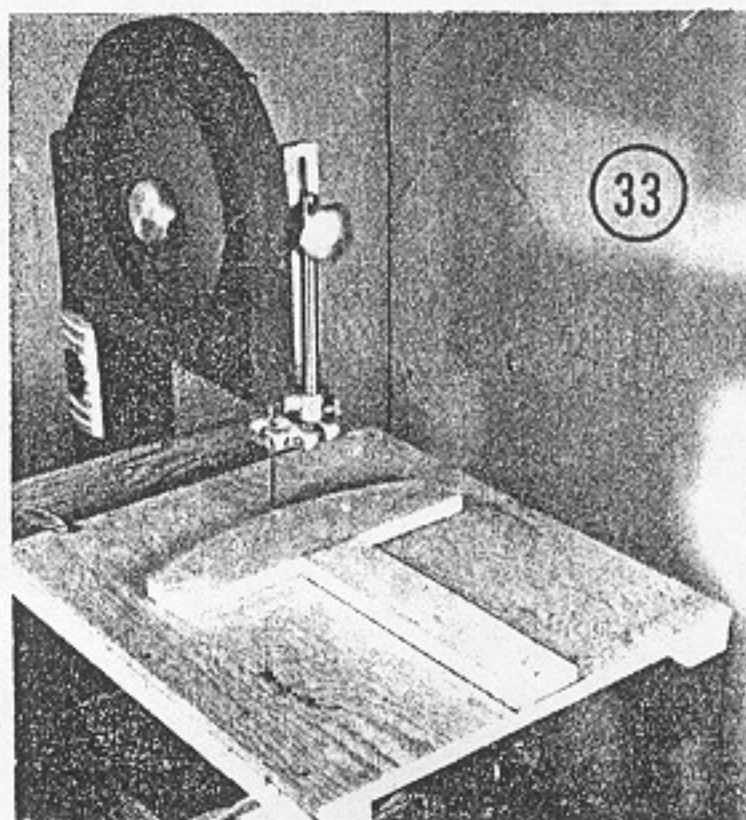


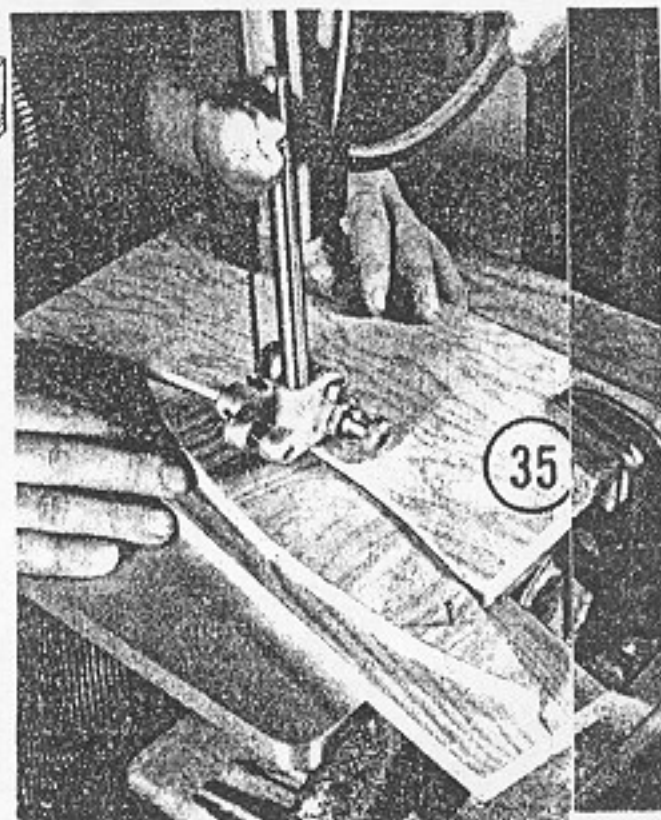
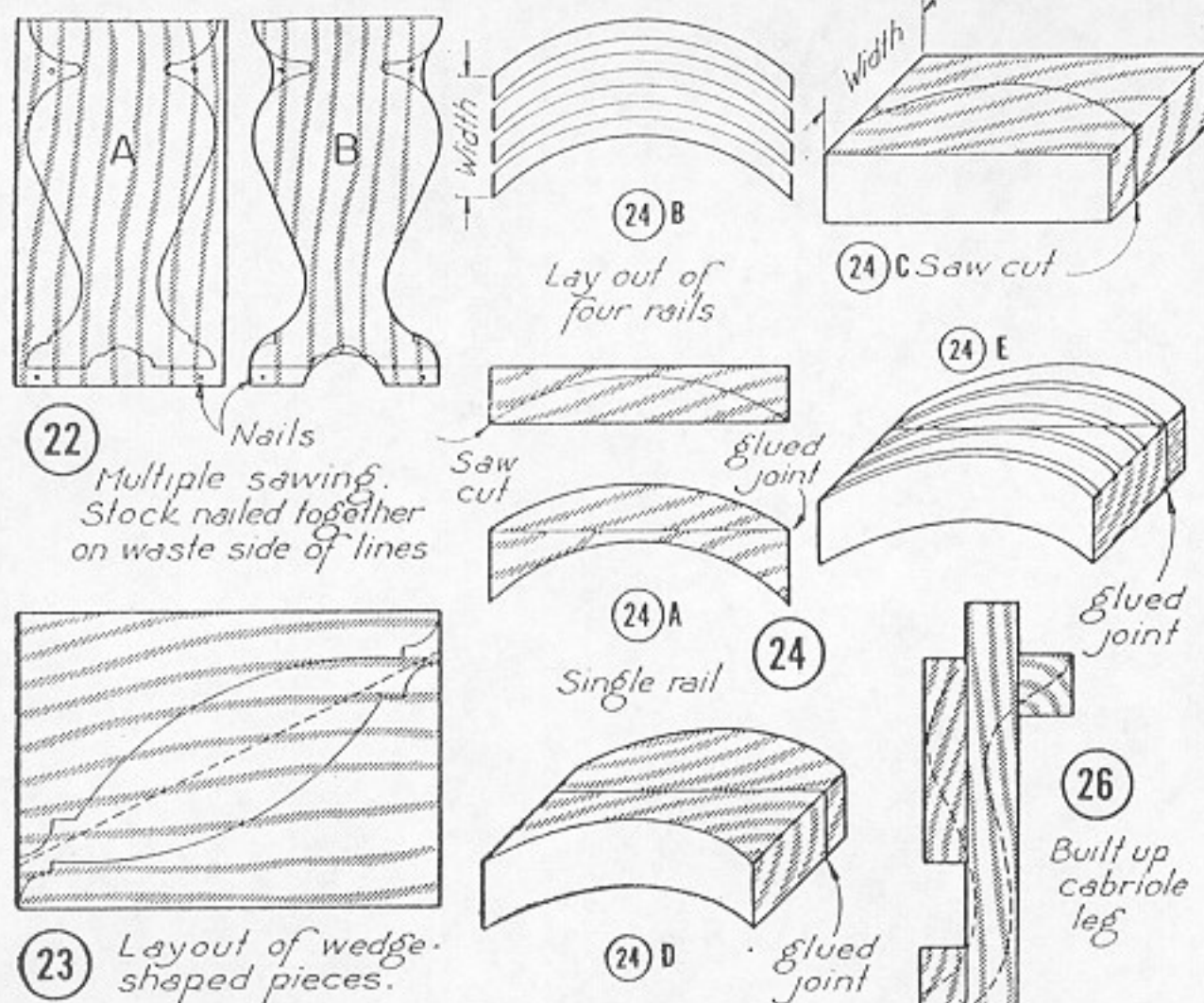
in a straight line and prevent it from being pushed off the wheels when stock is being sawed. Two guides are used, one

above the table and one below. The one below the table is fastened to the frame with bolts, but the one above the table is fastened to the guidepost, which is a piece of steel that is moved up or down to accommodate work of different thickness. A saw guide consists of two steel jaws or guide pins between which the blade slides. Behind the side guides, a small circular wheel spins around when the saw is running, and the rear edge of the blade is pushed against it. These small wheels prevent the saw from being pushed off the wheels, Fig. 4.

The guards on a hand saw are usually two metal doors or panels for the upper and lower wheels and two channel irons for the blades on the right and left side. The guard on the right side is fastened to the guidepost and moves up or down with that. The guard on the left side covers the saw between the wheels and is fastened to the frame. Therefore, only the part of the saw blade between the table

When segments have to be cut, the jig shown at left below may be used. The work is then swung as in Fig. 34. The view at the right illustrates a production set-up for sawing work to a pattern





SAFETY PRECAUTIONS

Although the band saw is considered one of the safest machines in the woodworking shop, it is well to observe a few simple safety rules.

1. Check the adjustments of the bandsaw blade by rotating the wheels by hand before turning on the power.
2. Move the guidepost down to within $\frac{1}{4}$ " of the stock to be cut.
3. Use only a saw that is sharp and properly set.
4. If a saw has to be backed out of a cut, let it be a cut which is short and straight.
5. Do not allow anyone to stand to the right of the saw because it may break and cause an injury.
6. Have no tools and scraps of wood on the table. Also keep the floor around the machine free from scraps and in good condition.
7. Do not cut until the saw is moving at full speed.
8. Use the narrowest blade for all scroll-saw operations and feed the stock to the saw with the right hand, using the left hand to help guide the work, but keep both hands well away from the saw blade.

Typical Bandsaw Operations. When a curve is less than 1" in diameter, bore a hole before sawing. The saw blade will run free in the hole and the stock can be turned in any directions, Fig. 12.

If it is necessary to saw a curve that is smaller than the saw will cut, make a series of radial cuts so that the saw will be free and the curve broken up, Fig. 13.

When boring a hole in a square corner, little triangular pieces remain which can be sawed off on the band saw, Fig. 14. When there is sufficient space, do not bore any holes, but saw the corners as in Fig. 15.

When sawing two or more pieces at the same time, mark only the upper piece. If the two pieces are symmetrical around the

and the upper saw guide, where the cutting is done, is unguarded as a rule.

Band saws are driven by direct motor drive, by belt and by chain. All such drives are well guarded on modern machines. The speed of band saws varies a great deal. The modern production machine may make 1200 R.P.M. while the small size saw may make only 600 R.P.M. Consult the manufacturer's directions.

Changing Bandsaw Blades. Bandsaw blades are changed because the blade that was on the machine may have been broken or damaged, become dull or lack set, or because a wider or narrower blade may be more serviceable for the work in hand. The changing is done as follows: Open the two metal doors in front of the two wheels and loosen the vertical adjustment screw. Remove the pin in the front or side of the table and lift the saw blade that is going to be changed off the wheels.

The bandsaw blade is usually coiled into three loops. To do this, grasp the blade in both hands and hold it as if it was on the machine, but with the back of the saw toward you, Fig. 5. Bend the teeth outward, which will cause the upper loop of the saw to bend downwards toward the floor, Fig. 6. Place upper loop inside the lower loop, Fig. 7, and move hands together until one is over the other Fig. 8. Then drop the loops and they will fall in place. The coiled saw may be hung up on a nail until it is convenient to sharpen or repair it.

The new saw to be put on the machine is then uncoiled. When putting the saw on, see that the teeth point down toward the table. If they do not, turn the saw inside out until this difficulty is overcome.

Push the guides back, tighten the vertical screw a little and revolve the wheels by hand. The saw should run in the center of both wheels and not as shown in Fig. 9. Correct any deviation from the vertical line by tilting the upper wheel. This is called "tracking the saw." On some saws the tilting mechanism is combined with the tension adjustment, Fig. 10. The saw is finally tightened up and the two guides brought forward and adjusted so that the gullets of the teeth are in line with the front edges of the guides. The guide wheels are also moved forward until they are $\frac{1}{32}$ " from the back edge of the saw. When the saw runs idly, it must not touch the guide wheels. Only when the saw is cutting should its back edge touch both guide wheels. If the saw were touching the guide wheels all the time, its rear edge would become case-hardened, which in time would cause it to break.

Bring the guides in line, Fig. 11, and the jaws as closely together as possible, while still letting the saw run freely between them. This adjustment can be made by placing a piece of paper on each side of the saw blade and then bringing the jaws together. If a saw leads to one side, that is, has a tendency to cut from the straight line, the cause may be improper adjustment of the guides or faulty setting. In the latter case, hold an oilstone against the side of the saw and a wooden block against the other and run the saw until the setting is even.

Making all these adjustments carefully will insure smoother, more accurate work.

center line, you need only prepare a half pattern, Fig. 16. To do this, lay out 1" squares from the drawing to the cardboard, and cut out the cardboard. Mark a center line on one board, place the cardboard flush with the center line and mark around it; lay the cardboard on its other side and mark once more. The complete outline is then made and the two boards may be nailed together and sawed. Cut a number of small, straight lines to free the saw and then follow the outline of the curves, Fig. 17.

An opening in the center of a board may be sawed on a band saw as follows: Cut the board in two at the center and nail the two halves of the board together as at A, Fig. 18. Joint the boards so they will fit and lay out half of the design from the planed edges. Then cut this out and smooth the sawed edges with sandpaper. The boards are then taken apart and glued as at B, Fig. 18.

The easiest way to hold boards together is no doubt by nailing them. When doing that, however, be sure to drive the nails straight so that there will be no danger of sawing into them. In other cases, however, it may be more advantageous to hold several layers of wood by other means, as for example to make a box as shown in Fig. 19. Another way is to drive thin wedges into the edges of the pieces, Fig. 20. In this case considerable waste wood is necessary. Still another method of doing multiple sawing is called the reverse method, because it is dependent upon the required number of pieces that can be cut from a solid block. First saw the solid block to shape and then rip off the required number of pieces either on a circular saw or on a band saw, Fig. 21.

In Fig. 22 is shown a method of sawing two ends for an end table. At A the two boards are shown nailed together and the drawing laid out on the top board. At B

is shown the first cut, which is continuous on both sides. The parts remaining can then be cut out in successive cuts.

Brackets for a shelf may be laid out as shown in Fig. 23, cut diagonally and then nailed together and cut to shape.

When it is desired to economize on the stock used for curved rails, the following method may be used: Lay out the curved rail and mark the outside curve on a narrow piece of stock, Fig. 24-A. Glue the two straight edges together and the rail is finished. If several rails are to be made, lay out the template of the curved rail as many times as necessary, but leave 1/16" for a saw cut between them, Fig. 24-B. Measure the width of the rails at

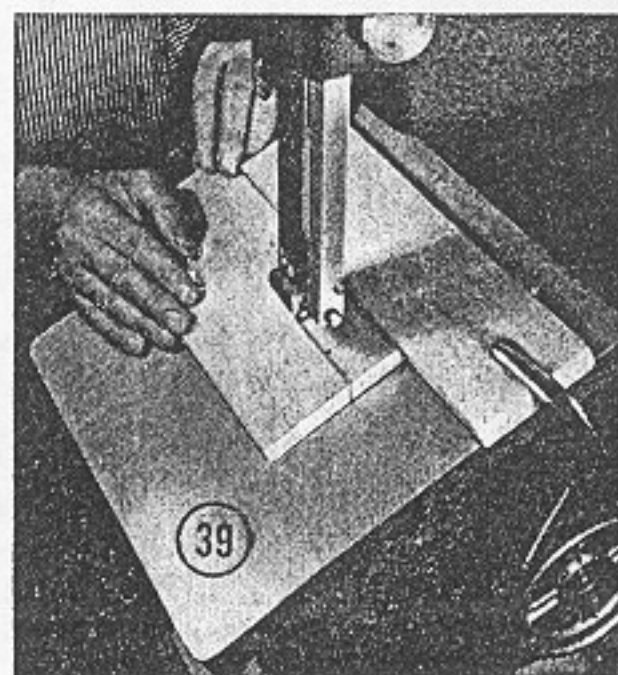
the ends or in the middle and cut a block of wood of the proper width. Place the template at any point and mark along its convex curve, 24-C. Saw the block in two along the curve and glue the straight edges together, 24-D. When dry, lay out and cut the curved rails from the template, Fig. 24-E.

Compound Sawing. By compound sawing is understood sawing from the same pattern on two adjoining sides of a square piece of wood. All forms of cabriole legs are sawed in this manner. A cabriole leg is usually square at the top and then curves outward. This part of the leg is called the knee. It then bends in again and terminates in a foot, which often resembles that of an animal.

Lay out the drawing accurately and make a cardboard pattern, which, if the leg is long, has an appendix that reaches to the rear side of the leg and helps to keep the pattern straight, Fig. 25. Square the stock to be used before marking it. Place the pattern on the squared stock so that its rear edges are flush with the same corner. The stock may be solid or it may be built up as shown in Fig. 26. Solid

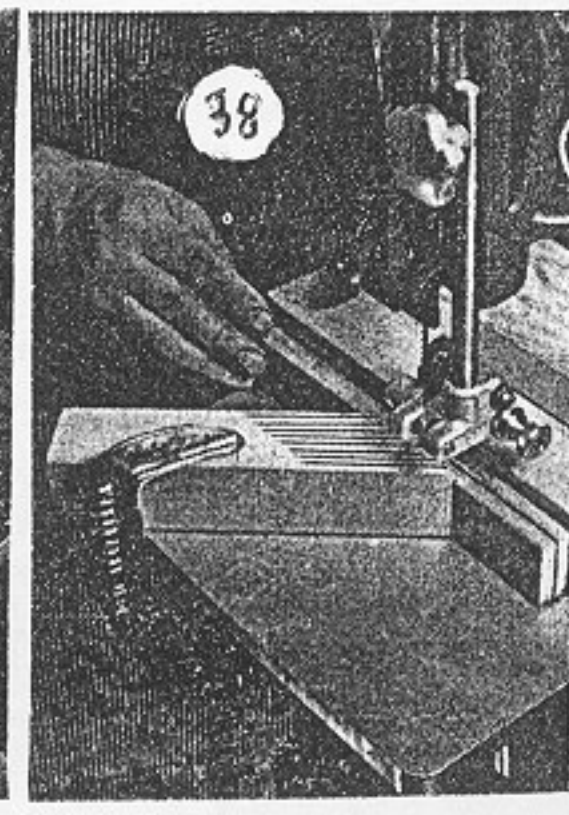
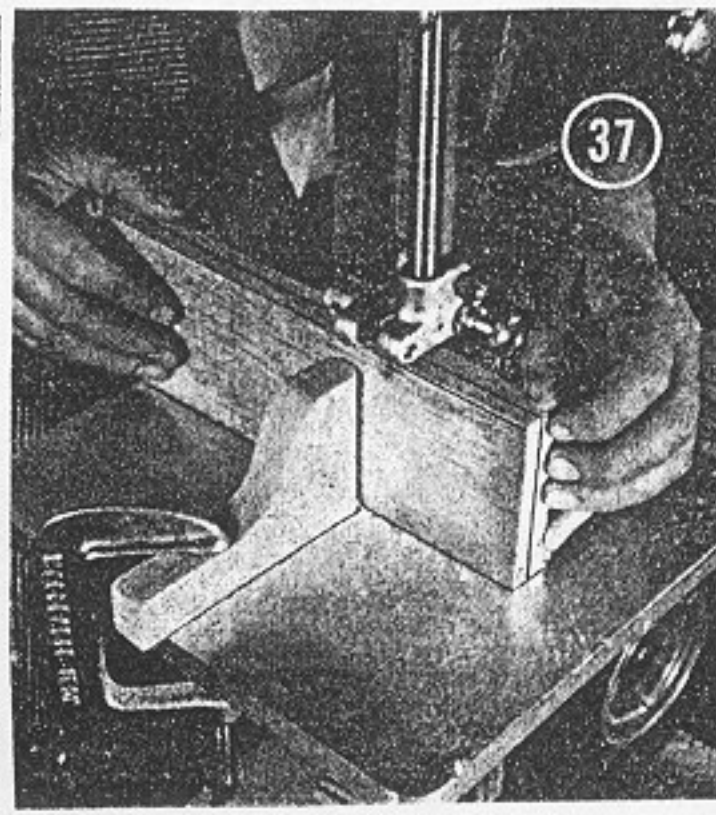
stock is the easiest to handle.

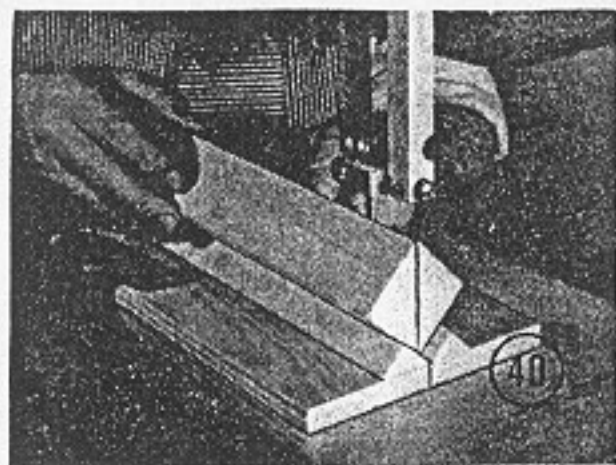
Use a narrow saw blade, about 1/4" wide, and begin sawing on one of the legs. It does not make any difference whether the front or the back is sawed first, because neither of them is sawed right through, but about 1/4" is left uncut on both of them. Back the saw carefully out of the first cut, and then make the second cut as shown in Fig. 27. Also back the saw out of the second cut. It will be quite easy since only 1/4" of stock is uncut. The reason for leaving part of the stock uncut is that it will rest on a flat side on the bandsaw table and that you will have the design on the other side to cut from. Now make the remaining two saw cuts all the way through as shown in Fig. 28 and discard the waste pieces. Complete the first two saw cuts by holding the upper square part flat on the saw table, Fig. 29.



Making a bevel cut with bandsaw table tilted

Cabriole legs often have little extensions to both sides called "ears" where the curve of the knee begins. These are generally sawed from a piece of molding





Cutting triangular blocks from square stock

previously planed to shape, after which they are glued in place and smoothed with file and sandpaper, Fig. 30.

Cutting Disks and Segments. If only a few circular disks are to be made, it pays to do so in the usual way by making a circle on each board and cutting one after the other. On the other hand, if many disks of the same diameter have to be made, it is better to do a little preliminary work so the disks can be cut on a pivot without marking.

First make an auxiliary table on the extreme right side of the saw table between the saw and the edge of the table. The table may be made of plywood and fastened to the bandsaw table with double wedges or C-clamps as shown in Fig. 31. Before fastening the table in place, lay out a line square to the saw blade, measure the radius of the disks, bore a hole through the auxiliary table and insert a screw from the bottom. File the projecting part of the screw to a sharp point and then fasten the auxiliary table to the regular bandsaw table. Press a piece of stock over the screw point and saw the first disk, Fig. 32. If it is too big, the auxiliary table is probably not close enough to the saw. Also, if the pivot point is not exactly at the right angle to the saw teeth, the saw will not follow the circle.

Segments, which are parts of a circle, may be sawed in the same way, only in this case the center is usually outside the saw table. A model of a regular segment

is fastened to an arm which swings on a dowel, Fig. 33. This segment must be adjusted so that every point of it must touch the saw when it is swung past it. Figure 34 shows a segment being cut.

Sawing After Patterns. This operation is used mainly in production work when a great many pieces of the same shape have to be made. First make the pattern, carefully cutting and smoothing the edges. Then make an auxiliary table or guide board of the same length as the bandsaw table. Its width depends upon the shape of the cut to be made. Supposing part of the shape is to be an arc, lay out the arc on one edge of this guide board. This arc should be laid out so that the saw blade will be in the center, where a little notch should be made for it.

Cut another board of the same length as the guide board, but not as wide. This second board must be a little thicker than the stock to be cut. It is nailed to the underside of the guide board. Drive two screws through the pattern from its top edge and file the projecting parts to sharp points. Press the pattern down on the stock to be cut and guide it along the curve in the

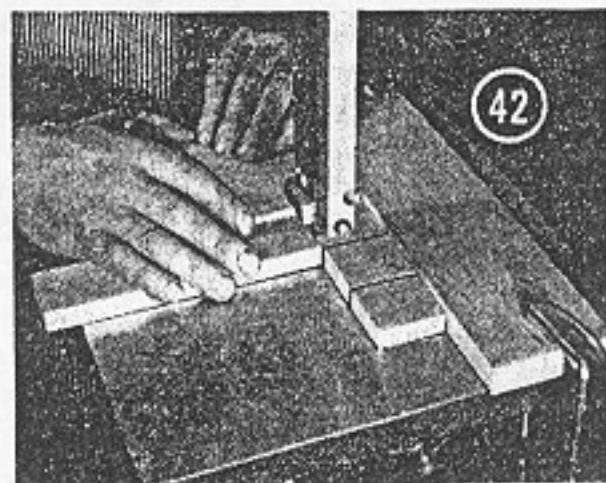


A miter gauge may be used for crosscutting on a bandsaw table which has the necessary slot upper board. The waste will lie on the saw table, Fig. 35.

Straight edges may be cut in the same way. It is very useful when stock has been glued up for a number of table tops. Nail a strip of wood at right angles to the boards, hold it against the straight-edged guide board and saw the ends

square, Fig. 36.

A pivot block, Fig. 37, is clamped to the table and used instead of the ripping fence if the saw leads to one side or the other. Another method of straight cutting is shown in Fig. 38.



Crosscutting with aid of a clamped-on fence

Bevels may be cut on the band saw if a guide board or ripping fence is clamped to the table at the right place and the table tilted to the desired angle, Fig. 39. Triangular blocks can safely be cut from square stock if a cradle is made for it to rest on while it is being sawed, Fig. 40.

Crosscutting. Crosscutting can be done on a band saw, especially if it is equipped with a miter gauge. The saw must be wide and in good condition, so that it does not lead to either side, Fig. 41. When crosscutting on a band saw, no clearance block is necessary, because a kickback is impossible on a band saw as only the cutting side of the blade moves down.

In case a miter gauge is not available, crosscutting may be done with a ripping fence. This is clamped to the left of the saw and a wide board with square ends is used against it instead of a miter gauge, Fig. 42.

Joints. In case a circular saw is not available, the following joints may be made on the band saw: Miter joints, tenons, slip joints and lap joints. The saw blade used should be the widest one on hand and it should be in perfect condition.

By GALE GORDON

FILING BAND SAW BLADES

POPULAR HOMECRAFT • FEBRUARY, 1944

THE user of band saw blades should know something about the filing of the teeth of his blades in order to get the most out of them. Nothing will break a blade as quickly as forcing it through work after it has become dull.

The matter of touching up the blade to keep it sharp is a simple one and requires just a little more patience than is needed to file a hand saw.

The only equipment necessary is a vise and a saw file of the proper size.

Photo 1 shows the touching up being

done while the blade is in the saw. Notice that it has been turned inside out so that the teeth point up instead of down.

The method of filing a band saw blade illustrated in Photo 2 is considered the better. Two boards of hard wood are hinged together at the bottom and clamped in the vise with the blade exposed.

An even number of strokes should be made across each tooth in order to keep the saw of equal width in its length.

Be sure to file the teeth straight across, not beveled as in the case of a cross cut hand saw. It is very important too that

the gullet or valley between the teeth always be rounded. On a fine tooth saw this is done automatically by the round edge of the file. On larger saws the gullet must be rounded with a rat tail file, taking out all sharp corners left by the three corner file. Keeping the gullets rounded prevents cracks from starting which quickly break the blade.

The teeth on your band saw blades may be touched up several times before it becomes necessary to re-set them.

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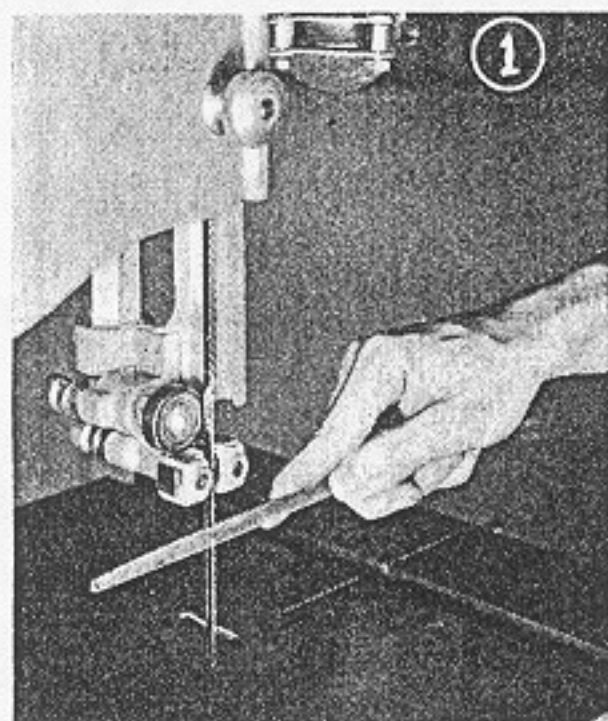


Fig. 1 —Touching up the blade while inverted in the band saw.

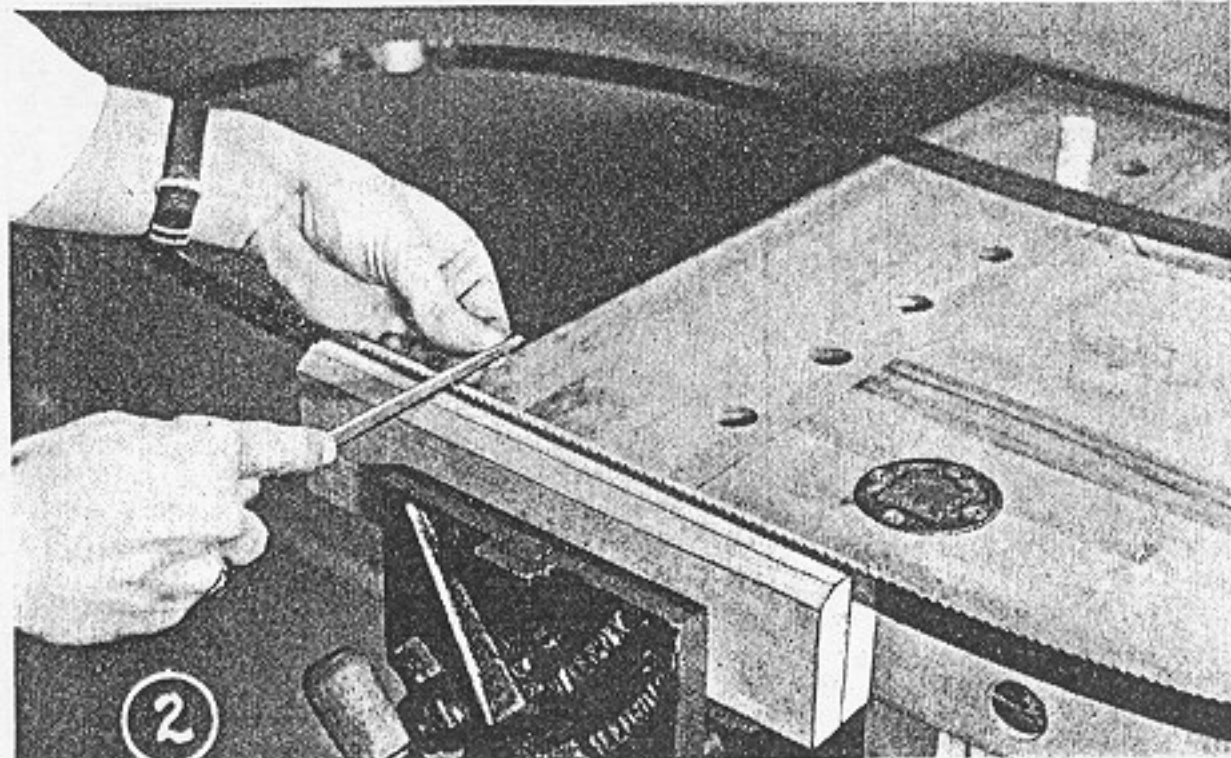
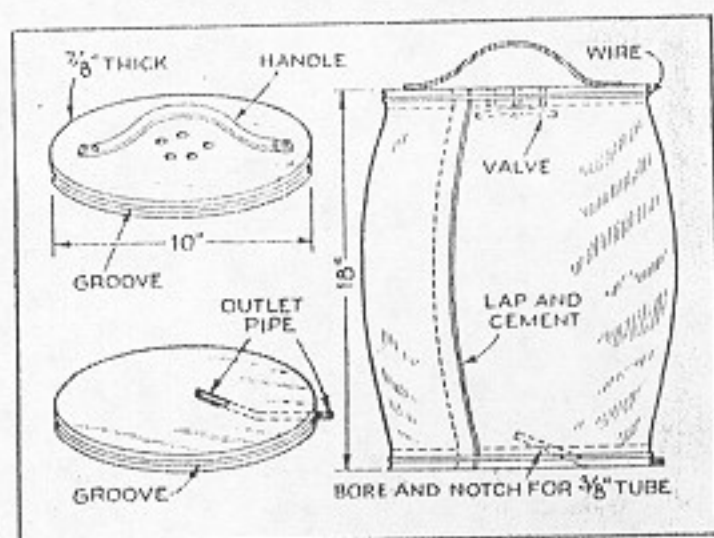


Fig. 2 —Blade gripped between two lengths of wood in the vise.



Simple Bellows Pumps Up Pneumatic Camp Beds Quickly

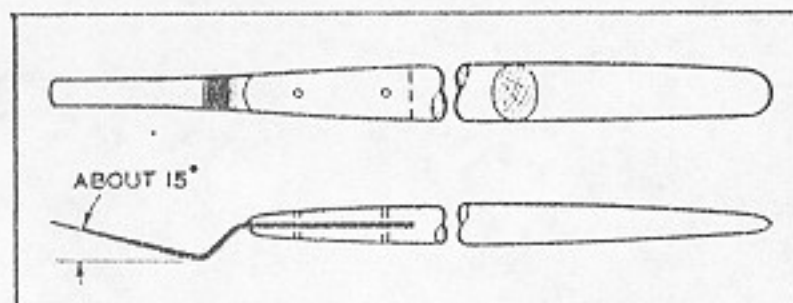
Wire clinches the rubber into grooves around top and bottom. The intake valve is a rubber flap held by a single screw



POPULAR SCIENCE JULY 1941

FILLING several air beds with a tire pump took so much time and hard work that I made the bellows illustrated from two wooden disks and rubber from an old inner tube, which was split along the inside and cut to lap over about an inch. To operate, the top disk is pulled up and pushed down slowly. About ten strokes will fill a bed, whereas it takes 200 or more strokes of a tire pump to do so.—F. R. SANBORN.

Popular Science FEBRUARY, 1946

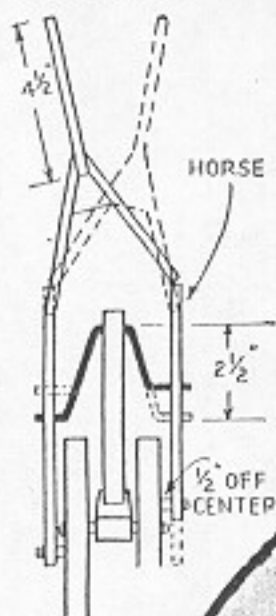


Palette Knife from Saw Blade

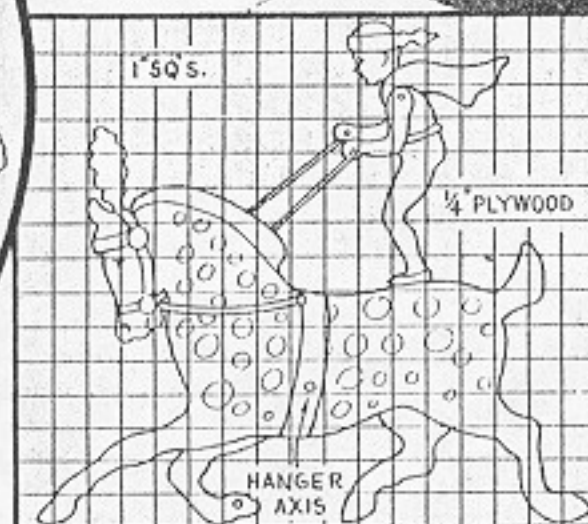
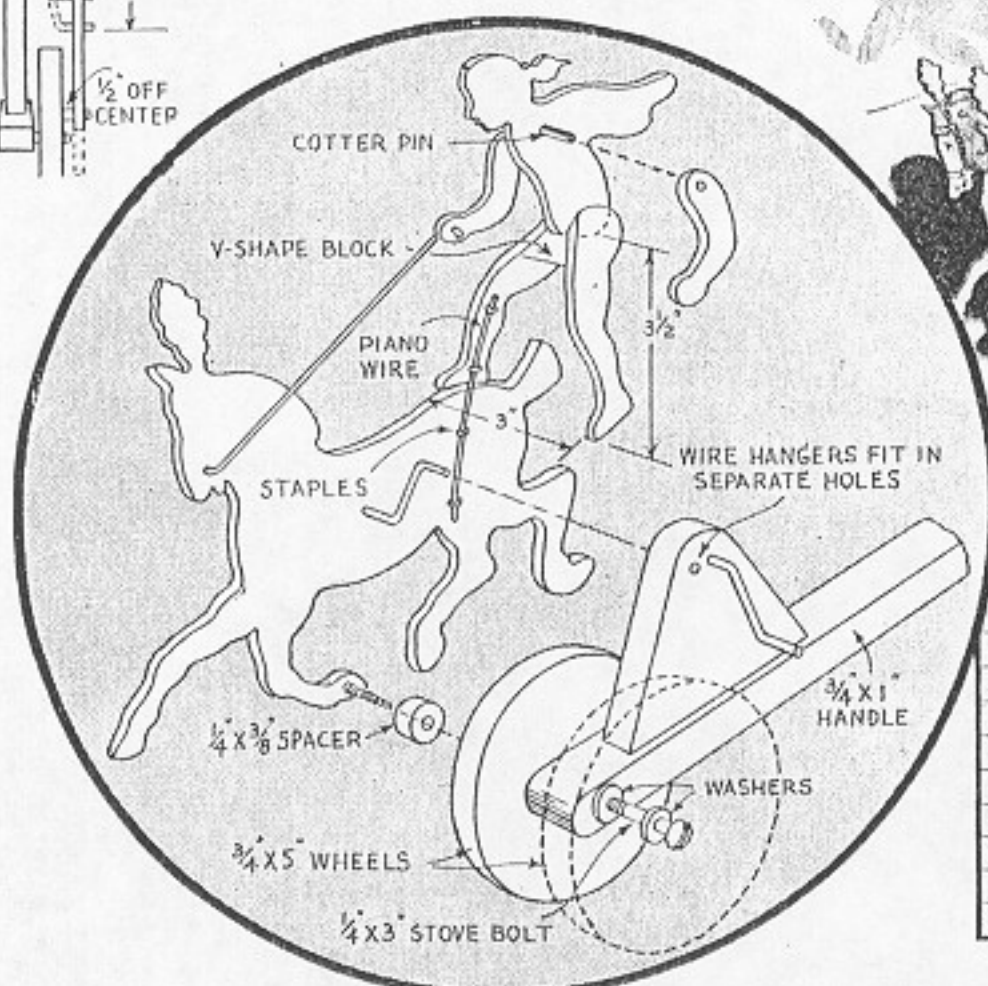
DISSATISFIED with the ordinary palette knife, I designed and made my own by inserting a 4" section of a soft-back hacksaw blade in a hardwood handle $\frac{3}{8}$ " by $\frac{5}{8}$ " by 8". The blade, bent without heating, was ground on the flat side of an emery wheel to taper from full thickness at the heel to quite thin at the point, and the edges were ground so that the width decreases from $\frac{5}{16}$ " at the handle to $\frac{1}{4}$ " at the tip. Small brads and glue hold the shank. The blade proper is $1\frac{1}{2}$ " long.—J. H. CLICK.

Circus-Rider Toy Performs in Realistic Manner

Popular Mechanics 1944



Galloping in a realistic manner when pushed on a floor or sidewalk, this little bareback rider never falls off his horses because each of his legs is attached to a horse with a length of piano wire, which permits much freedom of movement. His arms are pivoted at the shoulders and move in a lifelike fashion as he holds the reins of piano wire



Scrollsawed from plywood the horses are painted gray with darker dappled spots. The harness should be bright red with a touch of gold, and the rider painted in flesh pink tights with a blue cape and red bandeau. Galloping motion of the

horses is achieved by screwing the foreleg of each horse to the disk wheel on its side, $\frac{1}{2}$ in. off center. The horses are hung on wire hangers, which allow them to swing forward and backward as the foreleg makes the circuit of its crank.

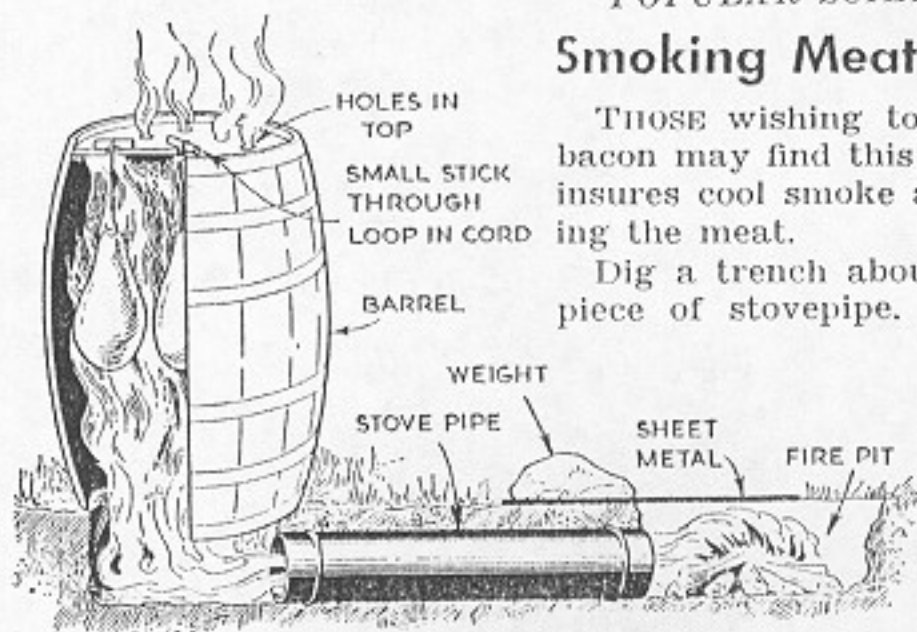
POPULAR SCIENCE APRIL, 1943

Smoking Meat with Barrel and Stove Pipe

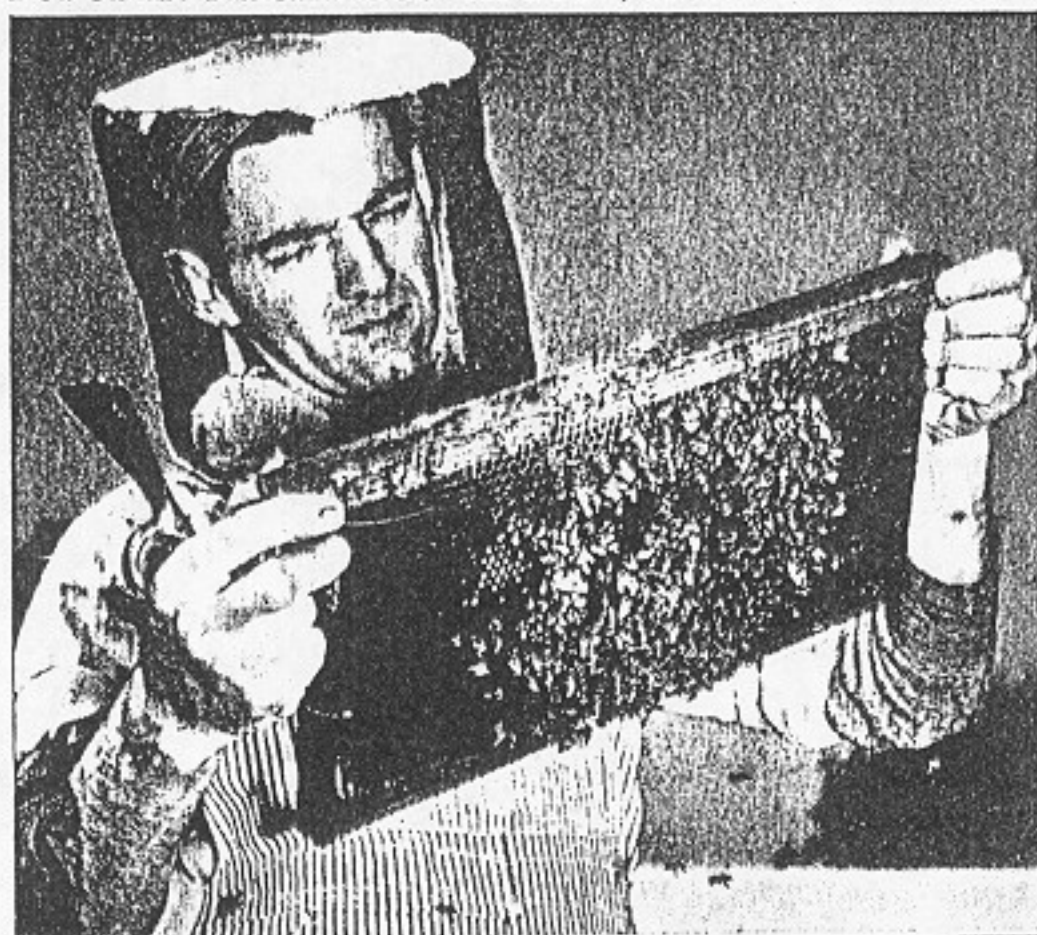
THOSE wishing to smoke only a few hams or sides of bacon may find this simple method of interest. The tunnel insures cool smoke and eliminates the danger of overheating the meat.

Dig a trench about 12" deep and twice the length of a piece of stovepipe. Bury the pipe in the middle of the trench. Over one of the open ends place a barrel upside down and bore a few holes in the top of it. Hang the meat with cords looped over small sticks.

In the other end of the trench build a fire with chips and corn cobs or hickory wood. Regulate the draft with a piece of sheet metal.



POPULAR MECHANICS AUGUST, 1942



IF YOU live in the country, you can save money by producing honey for your own use, or you can earn money by selling it.

Honey is twice as sweet as sugar and you use only half as much for ordinary purposes.

Fifteen dollars will outfit you with one hive, which will produce from 50 to 300 pounds of honey a year.

Last year beekeepers received an average of a nickel a pound for honey; early this year the price had risen to 12 cents and was still climbing.

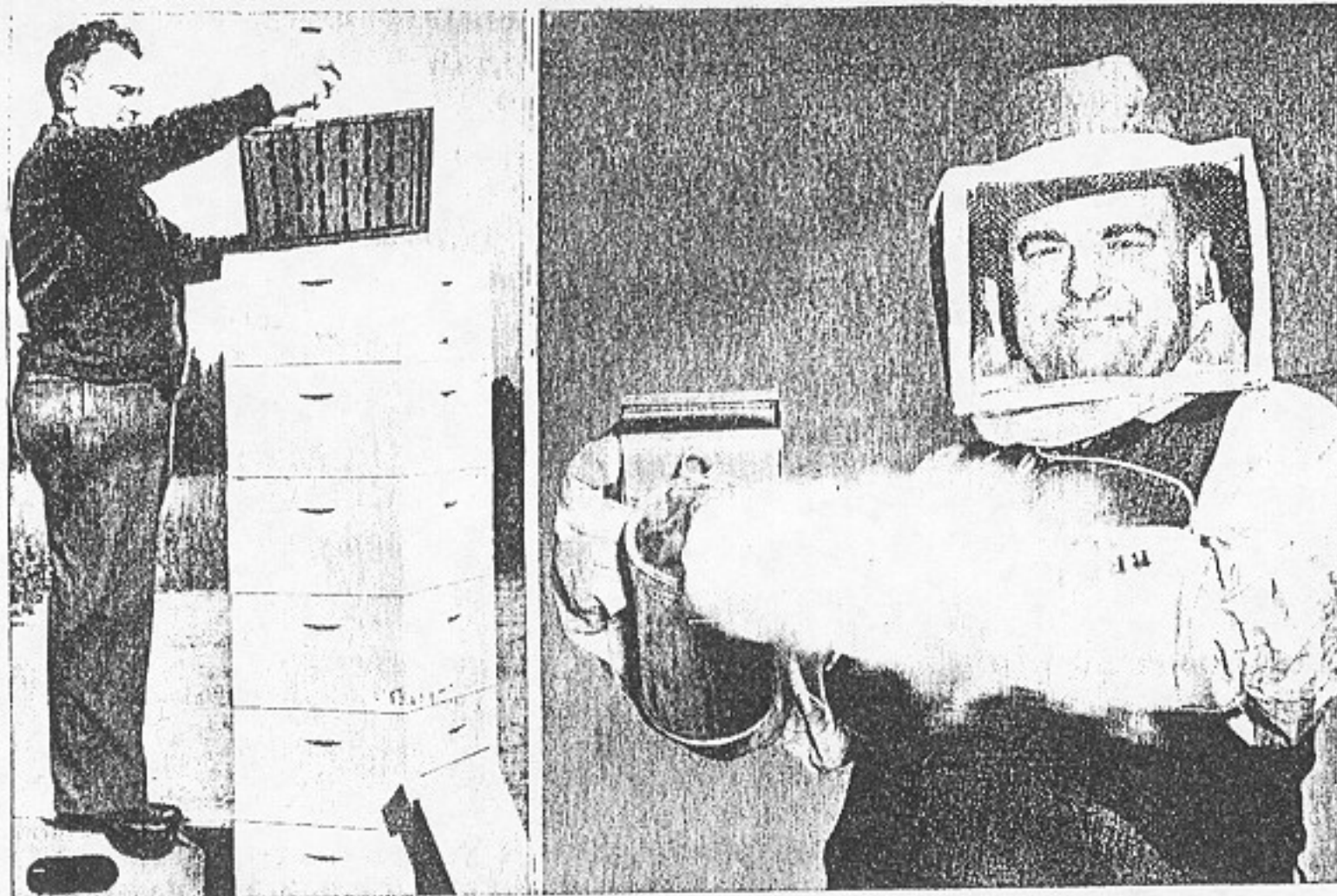
These are a few of the facts about honey that the sugar shortage has made important.

Honey is in demand today as a supplement of refined sugar. It may be used to sweeten tea and coffee, breakfast food, and for all cooking purposes. It is used by bakeries, soft drink manufacturers, and by candy and ice cream makers. Beeswax, a by-product of beekeeping, is also in big demand.

Bees flourish in almost all parts of the United States and if you would like them to go to work for you, consult your county farm advisor on the amount of food available where you live. He can also give you a few tips for starting your colony. Suburban flower gardens won't produce much honey and even in the country a difference of a few miles makes a big difference in

At top, a beekeeper—without benefit of gloves—examines a honeycomb from a hive of bees

Beeswax candles, profitable by-product, are manufactured by rolling a thin beeswax sheet



Left, a skyscraper of top supers that will be filled with honey by bees from bottom hive during a busy season. Right, a bee smoker that uses smoke from burning burlap to pacify bees while working around the hives

production. Clover is the biggest producer of nectar and yet bees have to visit 62,000 clover blossoms to create a pound of honey. In the middle west one hive of bees may be enough to satisfy the sugar requirements of a family while two hives will be needed in other areas.

From a bee supply house you can buy a wooden hive, knocked down and ready to be painted white and nailed together, for about \$3.50. The hive includes a bottom board, the empty hive box, the top cover, and ten frames and sheets of beeswax foundation. Two pounds of bees and a queen, enough to start the colony, cost \$2.75. You also need a honey storage box called a top super. This costs another \$2.50 and is placed on top of the hive, separated from it by an excluder grid that costs 65 cents. The top super may be emptied when partly filled with honey or more top supers may be placed above it.

Plenty of honey storage space must always be available to prevent the bees from swarming and starting a colony somewhere else. The type of top supers that you buy depends on whether you want comb honey or whether you plan to extract honey from the combs and keep it in liquid form.

Comb honey takes the least work but the advantage of extracted honey is that

Back of this upland apiary lives watchman to keep bears and thieves away





Pouring melted beeswax into molds. This wax is to be used by housewives for greasing their flatirons

the combs can be replaced in the top super after the honey has been removed. Relieved of the job of creating more wax, the bees can manufacture a greater amount of honey. To extract the honey you need a centrifugal extractor that costs upwards of \$20. For working around the hives you likewise need a \$1.00 bee smoker, a 75 cent veil, and a 55 cent hive tool.

The two pounds of bees with which you start the colony comprise about 10,000 bees. These should be placed in the hive at least six weeks before the honey season begins. The queen at once starts laying a couple of thousand eggs a day, which mature into bees in 21 days, and which then live and work an average of 45 days. At the peak of the honey season the hive will contain more than 50,000 individuals. Depending on their age, the bees perform various duties such as building honeycomb, gathering water, guarding the hive, collecting nectar, and feeding the queen. The nectar that a bee extracts from a flower consists of about one-third sugar and two-thirds water. The bee converts the sugar into honey and consumes about four-fifths of it, storing one-fifth in the combs. The beekeeper takes 60

percent of this stored honey, leaving 40 percent as food for the bees during the nonproductive winter season.

The first of May is about the right time to start a hive east of the Rockies, while in the west and in the extreme south the hives can be started a month earlier. The season lasts all summer and the bees wind up their work when the asters and golden-rod finish blooming in the fall.

When starting a new hive you should feed the bees with a thick cane sugar and water syrup in a bee feeder placed in the hive. Never feed honey from another colony to a new hive of bees.

Honey production will depend on the availability of food. The hives should be placed within a mile or so at most of some flowering crop, wild or cultivated. Some beekeepers place their hives down wind from the crop in areas where the prevailing wind is steady, so that the bees can "coast" home with their loads of nectar. Production runs from 150 to 300 pounds per hive per year in the middle west to as little as from 25 to 200 pounds in California. Low production in California is because the state has the largest bee population in the country, making for reduced produc-

Placing a filled honeycomb in extractor which will whirl honey out centrifugally without injuring comb



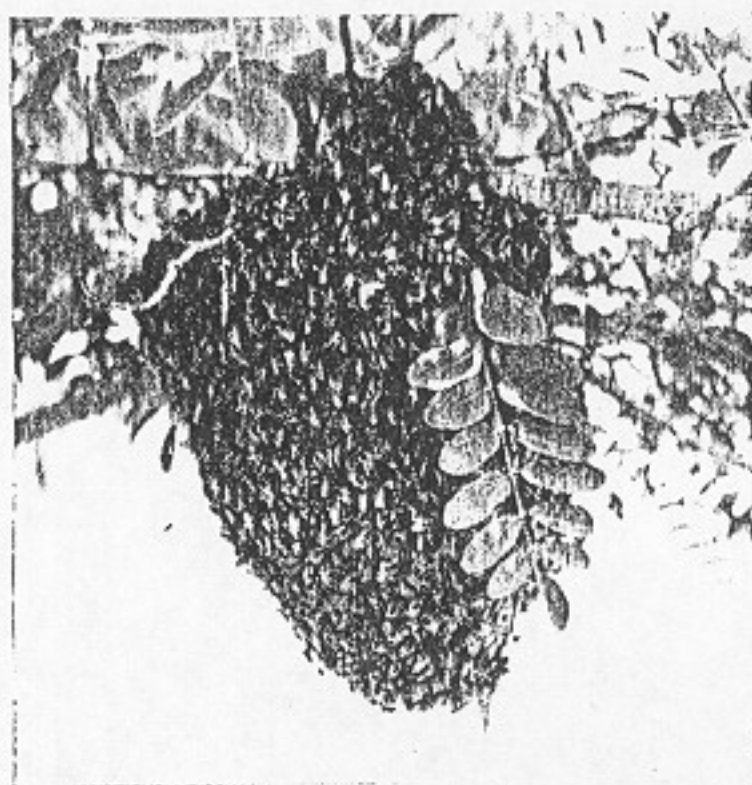
tion per colony, and because of the limited nectar-producing crops in that state. These factors have caused some western bee keepers to follow the crops with their hives. Albert C. Mayer, for instance, operator of the Honeyville apiaries at Monrovia, Calif., has 2,000 colonies that he transports to the local orange groves during the winter blooming season, moving them to the desert when the oranges finish blooming and the wild desert sage begins to bloom, and later taking the hives to still other locations when the wild buckwheat comes into flower.

Beekeepers and farmers form a co-operative team because if it were not for the bees there would be practically no crops. In gathering nectar the bees perform the important duty of pollenizing the flowers. Some insecticides will kill bees as well as injurious insects so farmers try to notify local bee keepers ahead of time when crops are to be dusted, so that the bees can be moved temporarily. Once, in California's Imperial Valley, the owner of a large acreage planted to peas forgot to tell the beekeepers that the crop was to be dusted against aphids and the result was that all the bees in the fields were killed. That was one result;

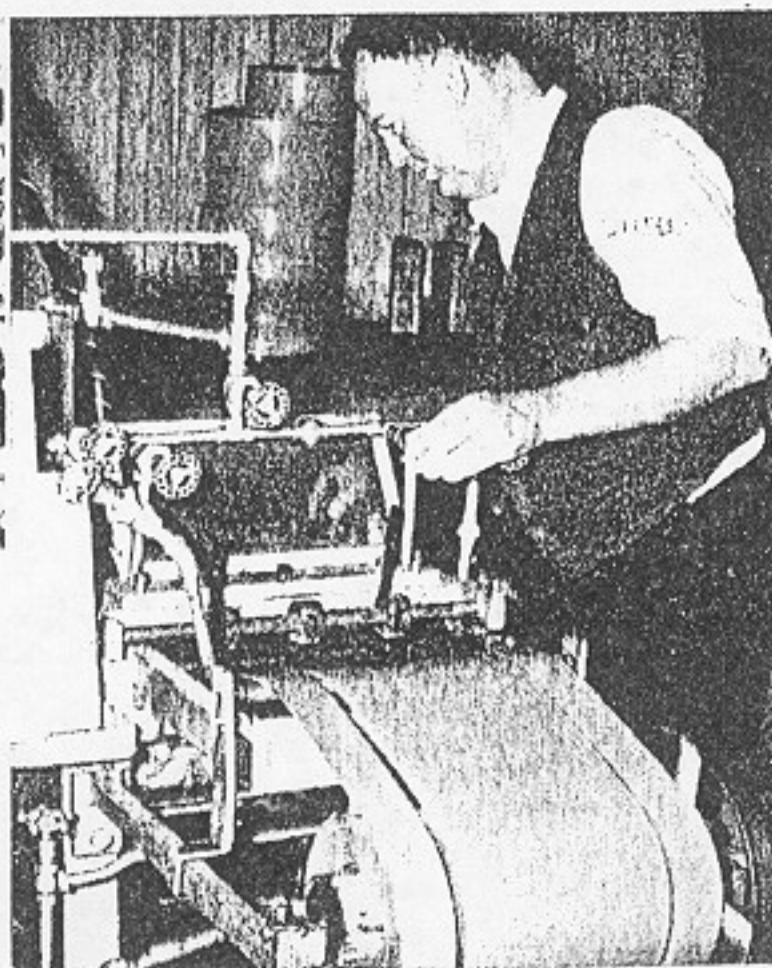


The beekeeper places a new queen in colony at start of season. Bees usually do not sting hands and arms where skin is tough

another was that there was no pea crop that year. The pea flowers weren't pollenized, hence when the pods matured they contained no peas. The impression that bees ruin such crops as apples and grapes by eating the fruit is wrong. The bees feed only at wounds caused by birds.



Bees have swarmed to the tree, above, because the honey storage capacity of their hive was too small. At the right, refined beeswax is seen coming out of a press in which it is being rolled up into coils



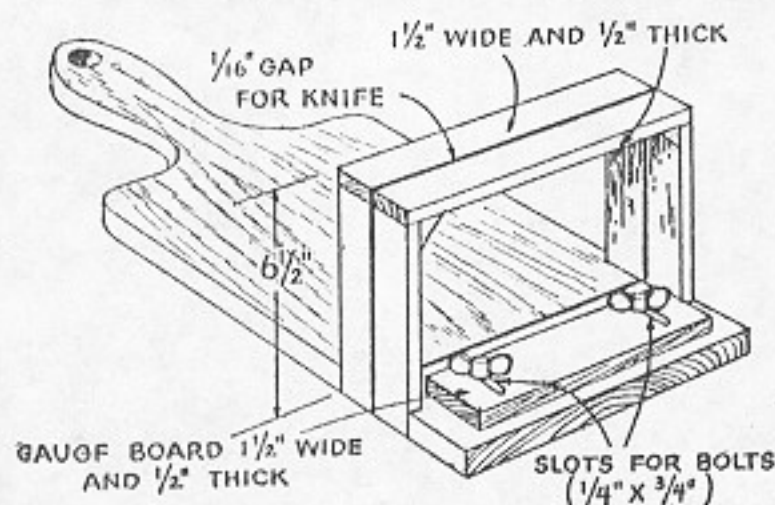
Some of the bees will sting you now and then, of course, but how often depends on several things. Of the three races of bees most used in the United States, the Caucasian bee is one of the gentlest, the Italian bee is fairly gentle, and the Cyprian bee is the "hottest." But the Cyprian holds the world record for honey production. Colonies of stingless bees have been developed but such bees generally are pretty poor honey producers.

The best defense against stings, of course, is proper dress. Most beekeepers protect their heads with a veil or wire screen but few of them bother to wear gloves. Hives should be kept in lonely spots where the bees are not apt to be disturbed. The bees should be approached during the hottest part of the day, when they are inclined to be lethargic. Taking a bath just before approaching the hives is said to decrease the chances of getting stung. Never stand directly in front of the opening of a hive.

A few puffs of smoke from a bee smoker pacifies the insects when top supers are being changed or combs are being removed.

You must beware of two bee diseases, neither of which will affect the quality of honey as far as humans are concerned. The so-called American foul brood is highly contagious and to combat it the bees and honey must be completely destroyed, the interior of the hives burned out, and an entirely fresh start must be made. European foul brood may be combatted by killing the queen bee and obtaining a new queen of healthy stock.

Right now beekeepers are receiving returns that amount to one or two hundred percent per year on their investment, although they estimate that after the cost of their own time is deducted their profit amounts to about 33 percent per season. Anyway, there's money in honey these days. But be careful! Even if your beekeeping is a success you may get stung!



Popular Science April 1943

Bread-Knife Gauge Assures Thin and Even Slicing

HOUSEWIVES and those men who like to do a turn in the kitchen are now hacking away unfamiliarly with the bread knife after years of buying bread presliced at the bakery. For those who have lost the expert touch, here is a bread "miter box" to put an end to thick, jagged hunks and help toward the Government's goal of less waste. It not only assures even cutting, but also has an adjustable stop for making uniform slices of any thickness desired.

The base is an ordinary bread board, such as can be obtained at any store handling kitchenware. The knife guides are made from maple, built in two sections, as shown, and spaced $\frac{1}{16}$ " apart to allow free movement of the knife without wobble. Dado the edges of the baseboard and attach the frame

with glue and countersunk screws. Blocks reinforce the upper corners. A $\frac{1}{8}$ " deep groove may be sawed across the board to receive the knife at the end of its stroke, so as to minimize dulling of the edge.

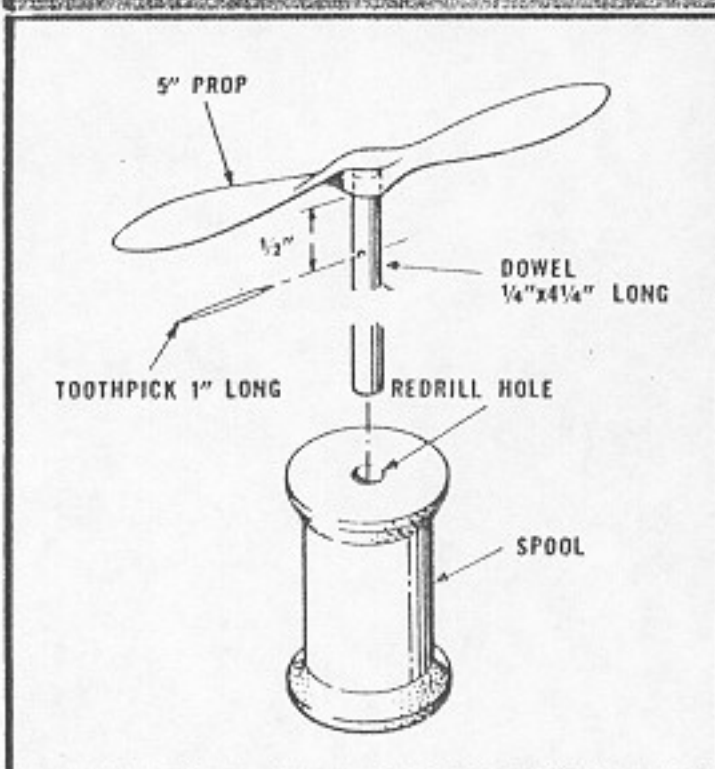
Drive square-shouldered carriage bolts for the thickness gauge into counterbored holes from beneath. They should be tight enough not to turn when the wing nuts are being tightened. A slice-thickness scale may be marked on the board.

In slicing bread, use a long, sharp knife with either a plain or scalloped edge, and cut with a sawing motion. Very fresh bread is likely to be soft and will give even with minimum pressure. This can be offset by turning the loaf on its side and slicing against the harder crust of the bottom.

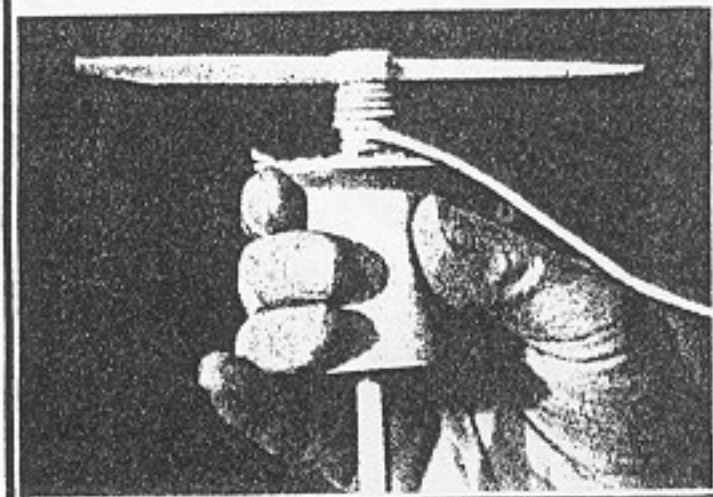
How To Build It 1964



FLYING TOP



WITH cord wound around upper shaft, hold onto spool and give a quick yank.



A TRADITIONAL TOY, this high-flying top consists of nothing more than a short length of dowel, a small prop and a spool. A cord wound around the upper part of the shaft, just below the prop, serves as the impeller. A quick yank will send the top soaring to a height of about 100 ft. After reaching its peak, the top will spin lazily to earth.

Cut the dowel to size, then drill a small hole near one end to hold a toothpick, as shown. Next, take the prop and redrill the hole for a tight fit over the shaft. Apply a little model cement to prevent the prop from working loose and press firmly into place. Dab some cement on the toothpick joint also.

The size of the spool is not important, provided the hole through it is large enough to prevent binding against the dowel. Redrill if necessary. You can add to the effectiveness of the toy by painting a colored spiral around the spool. Rub a little paraffin on the top surface of the spool and on the dowel to reduce friction and the top is ready for the flight line. •

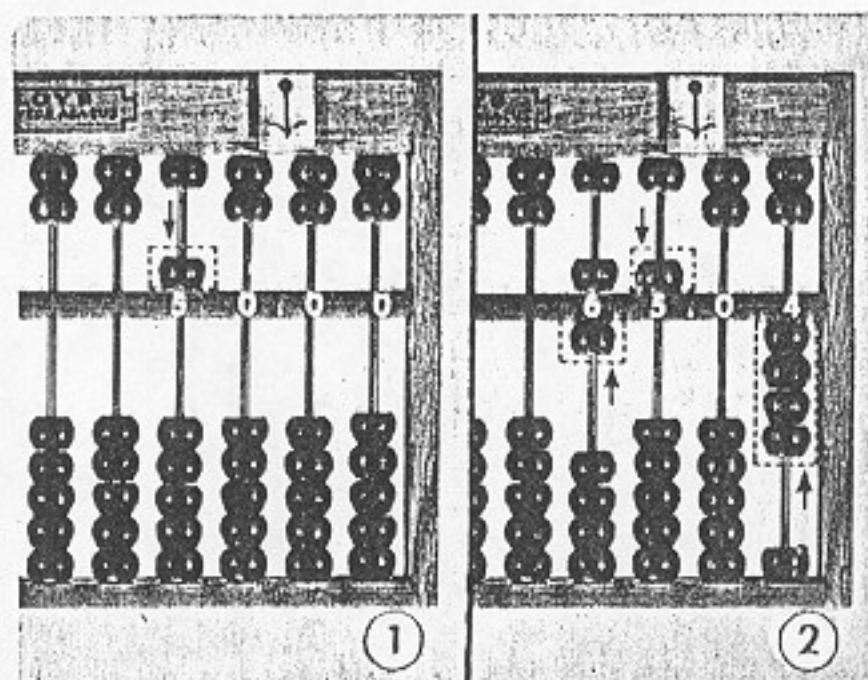
—J.C.

How to Use an Abacus

Popular Science August 1949

By W. D. Loy

*Inventor and Manufacturer of
Loy's Improved Chinese Calculator*



Addition. John Doe starts pay-check problem with abacus cleared: all beads above crossbar pushed up, all below pushed down. Arrow between second and third columns from right marks decimal point. A top bead (5) in fourth column from right is pushed down (Figure 1) to enter on abacus his weekly wage: \$50.00. To add overtime pay—\$15.04—Doe pushes up four lower beads (1 each) in righthand column, pulls down an upper bead (5) in first column to left of decimal, pushes up a lower bead (1) in next column to left. Total (Fig. 2): \$65.04.

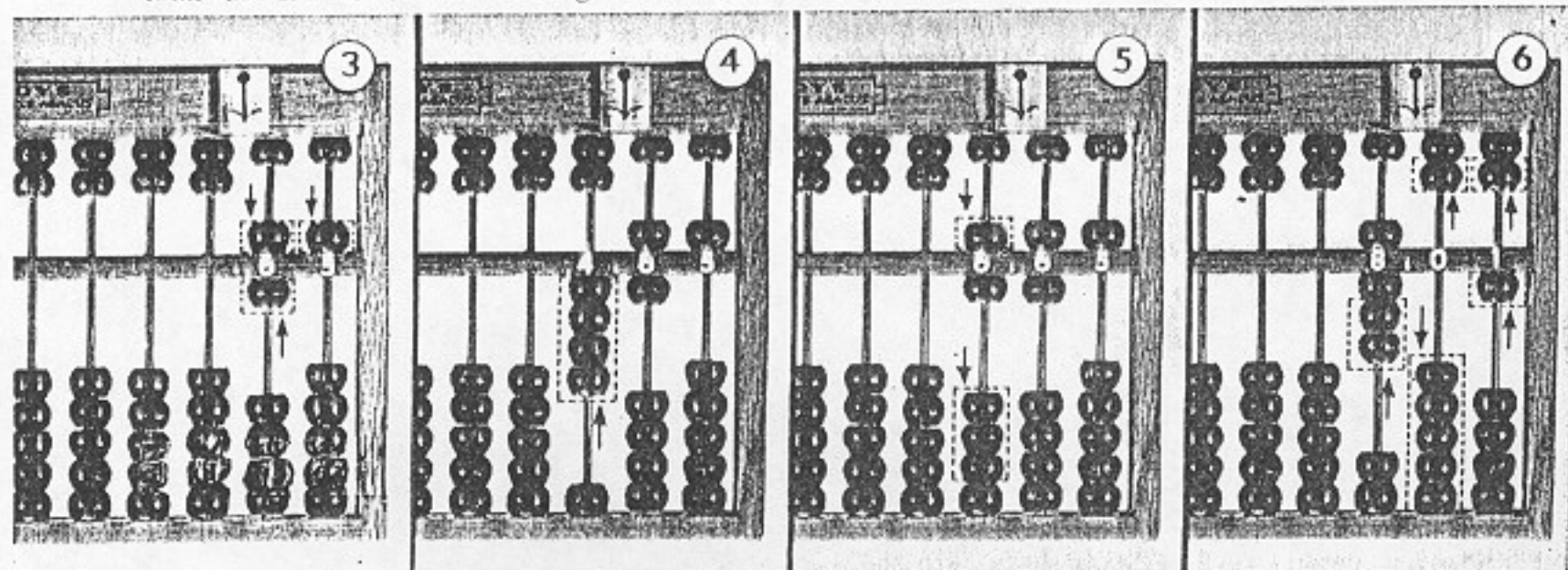
To add up his deductions, Doe clears the abacus again. He sets the arrow between the second and third columns from the right, as before, to indicate the decimal point. Now he enters \$.65, his social-security payment, by pulling down an upper bead in the right-hand column for the 5, then pulling down an upper bead (5) and pushing up a lower bead (1) in the next column to the left for the 6. The result is shown in Fig. 3. Next he adds \$4.00, withheld for his Federal income tax, by pushing up four lower beads in the first column to the left of the decimal point. That gives him a total so far—as shown in Fig. 4—of \$4.65.

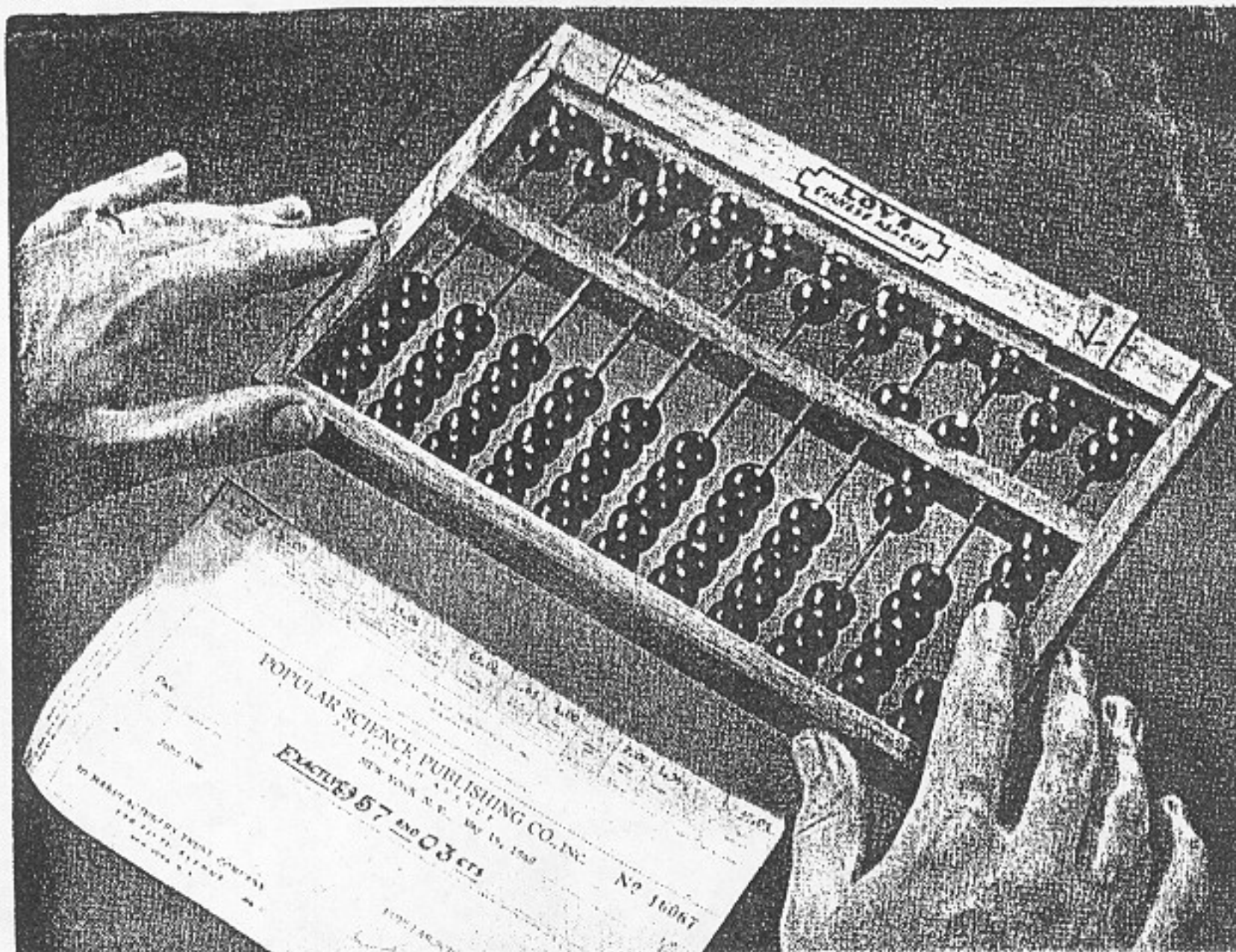
EVER watch a Chinese shopkeeper figuring his accounts on an abacus? There's no good reason why you too can't use his simple arrangement of beads on wires. For the abacus is not only the world's oldest calculating device, but also the cheapest—and not half as hard to run as it looks.

Suppose you wanted to check the figures on your pay check with an abacus. These pictures of how John Doe re-figures his pay, step by step, show how you would do the adding, subtracting, multiplying, and dividing.

Each column of beads on the abacus represents a digit, and figures are read from left to right in the normal manner. Beads below the crossbar in each column have a value of 1 each; those above, 5. A column is clear—representing 0—when all its lower beads are pushed down, away from the crossbar, and both its upper beads are pushed up. A digit then is entered by sliding the required number of beads up or down to the crossbar.

U. S. bond deduction of \$2.00 is added by pulling down an upper bead (thus adding 5) and pushing down three lower beads (subtracting 3) in first dollars column. This gives a total (Fig. 5) of \$6.65. To this Doe adds his hospitalization deduction of \$1.36. New 6 plus old 5 in right-hand column make 11; so 1 has to be carried over into next column—just as in adding on paper—leaving 1 in the first column. In the second column, 3 plus 6 plus the 1 carried over add up to 10; so column is cleared, and 1 is carried over to third column. There 1 plus 6 plus the 1 carried over make 8. So total now (Fig. 6) is \$8.01.



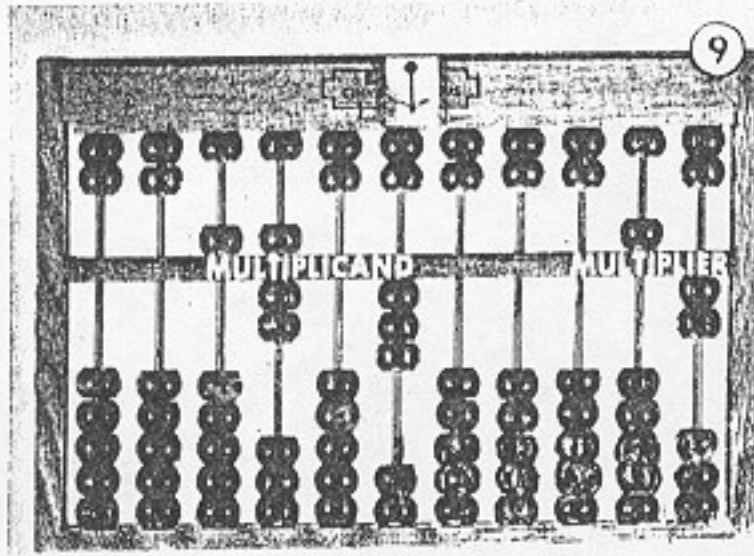
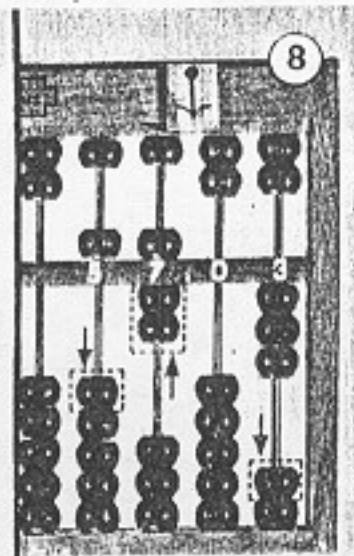
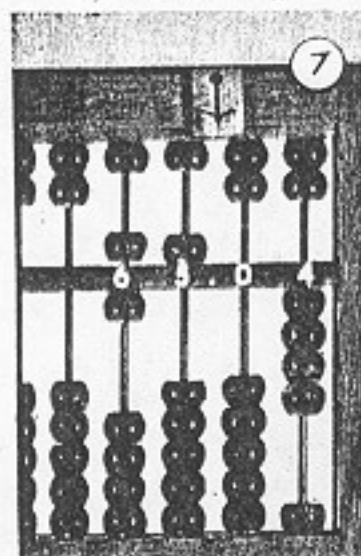


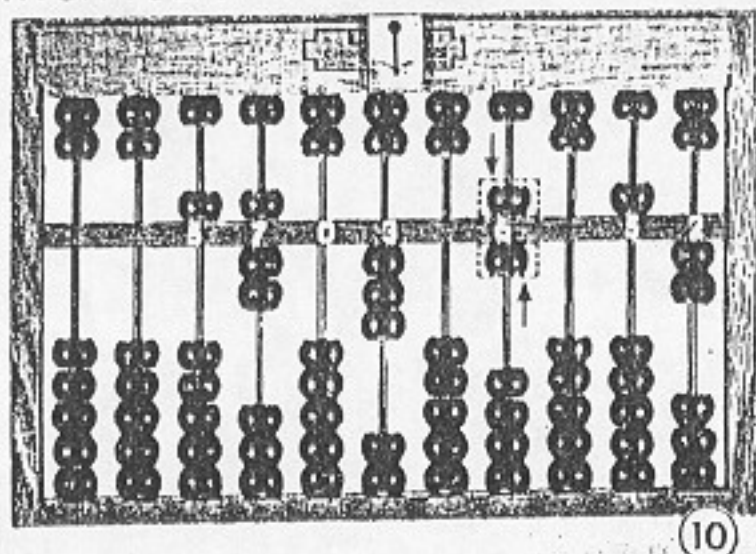
Chinese abacus has five beads below crossbar in each column, two above it. Japanese have one with single row of upper beads; other variations were used by ancient Egyptians, Greeks, and Romans. Author of this article in-

vented sliding pointer to locate decimal point or mark column being used in multiplication or division. This model sells for \$6.50, and can be purchased by mail from him at 1317 Rhode Island Ave., N.E., Washington, D.C.

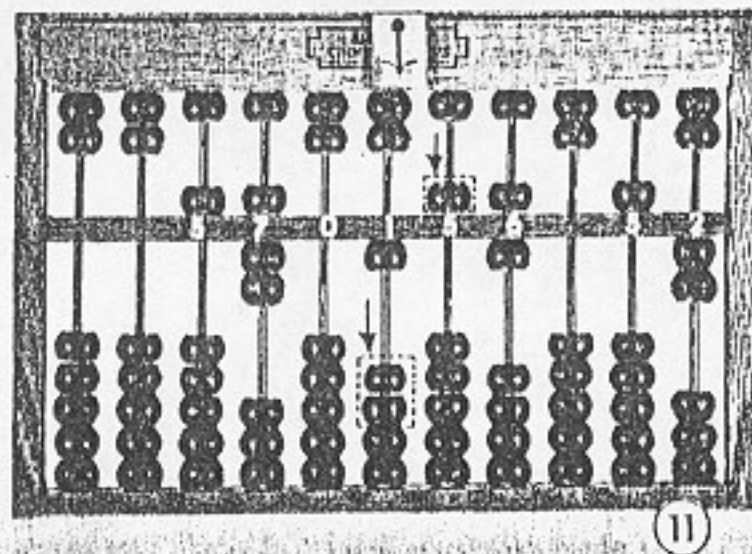
Subtraction. Now Doe wants to subtract his deductions—\$8.01—from his weekly pay. He clears the abacus, then enters on it (Fig. 7) his total pay of \$65.04. Subtraction is, literally, taking away. To take \$8.01 from \$65.04, he first pulls down one lower bead in right-hand column. Zero from zero is zero; so second column is unchanged. Since he can't take 8 from third column—it has only 5 registered—he gets same result by adding two lower beads there and taking away one lower bead (representing 10) from fourth column. Answer—\$57.03—shows (Fig. 8) that the company cashier paid John Doe right amount for his week's work.

Multiplication. Next Doe wants to find out how much he'll take home in a year if he keeps on earning at this rate. To get that, he must multiply \$57.03—his weekly check—by 52 weeks in a year. He puts the multiplier, 52, on two right-hand columns (Fig. 9, below). The multiplicand, 5703, goes on any four columns to the left, leaving some space in the middle for figuring. Decimal is disregarded during the calculating and will be inserted later in answer, since its position doesn't change in figuring dollars and cents. The sliding arrow, no longer needed for decimal, will be used to mark the column on which he is figuring.

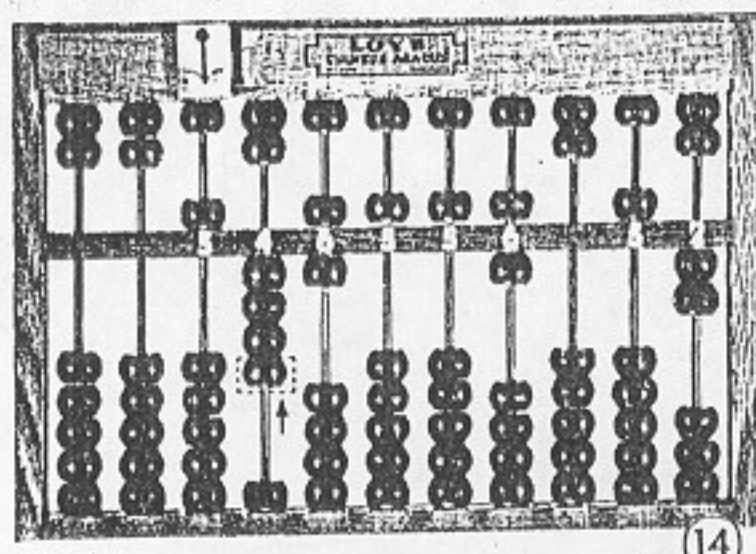




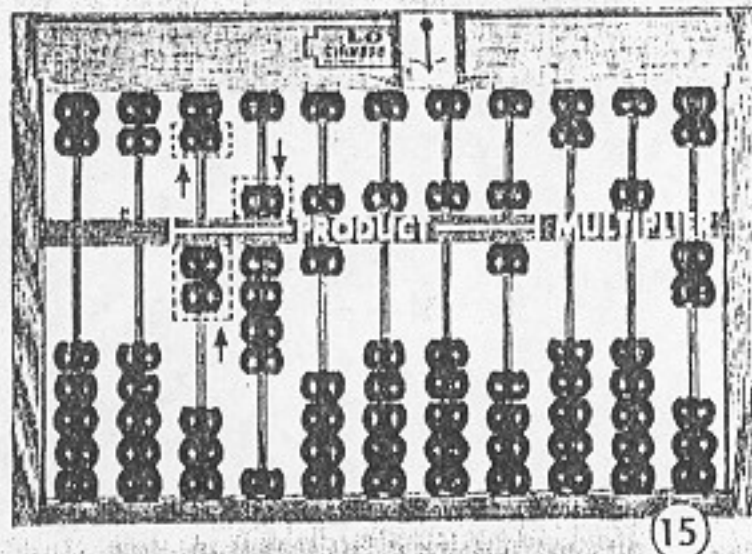
Multiplication starts from the right and is based on multiplying single digits, as on paper: $3 \times 2 = 6$. Products of right-hand digit of multiplier go as many columns to right of the digit being multiplied as there are digits in multiplier (52). Doe puts 6 two columns to right of 3.



Next he multiplies 3 by 5. Since the 5 is one column to left of the 2 in the multiplier, its products go one column farther left. So Doe puts 15 (3×5) to left of his 6 (3×2). Because he has now multiplied 3 by both digits of 52, he can get rid of it to make room for the 15.



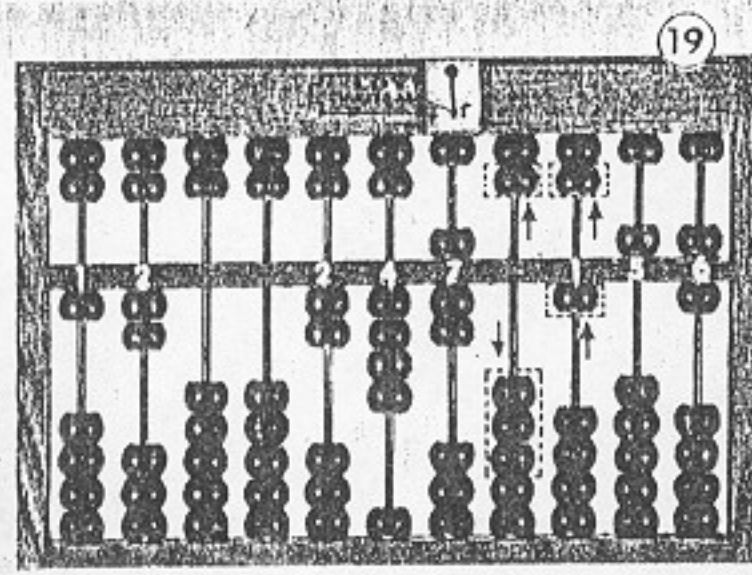
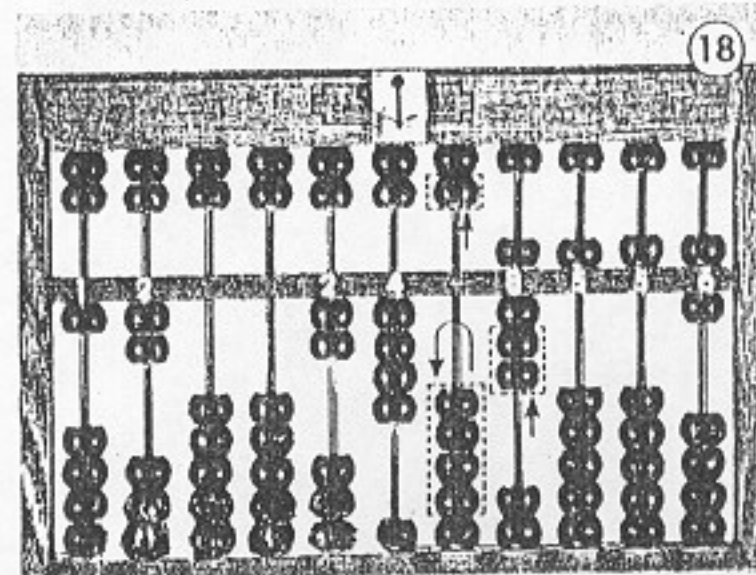
Arrow is moved to indicate that Doe now is working on the 5 column. He multiplies it by the right-hand digit—2—of the multiplier: $5 \times 2 = 10$. He adds the 10, again beginning two columns to right of the number being multiplied—5. This he does by adding 0 to that column and 1 in the next column to the left.



Final step: $5 \times 5 = 25$. As before when multiplying by the 5, product goes only one column to right of the number being multiplied. This finishes multiplication; Doe discards 5 in multiplicand and enters 25 by adding 2 under arrow and 5 to next column to right. Answer, with decimal, is his yearly take-home pay: \$2,965.56.

Again (below) Doe divides by 12. It goes four times into 56—now the first two figures of dividend. He enters 4 in quotient, moves arrow over it, and subtracts 48 (4×12) from 56. He takes the 8 from right-hand column by adding 2 and subtracting 10 (one bead in next column to left). He then takes 4 from left-hand column.

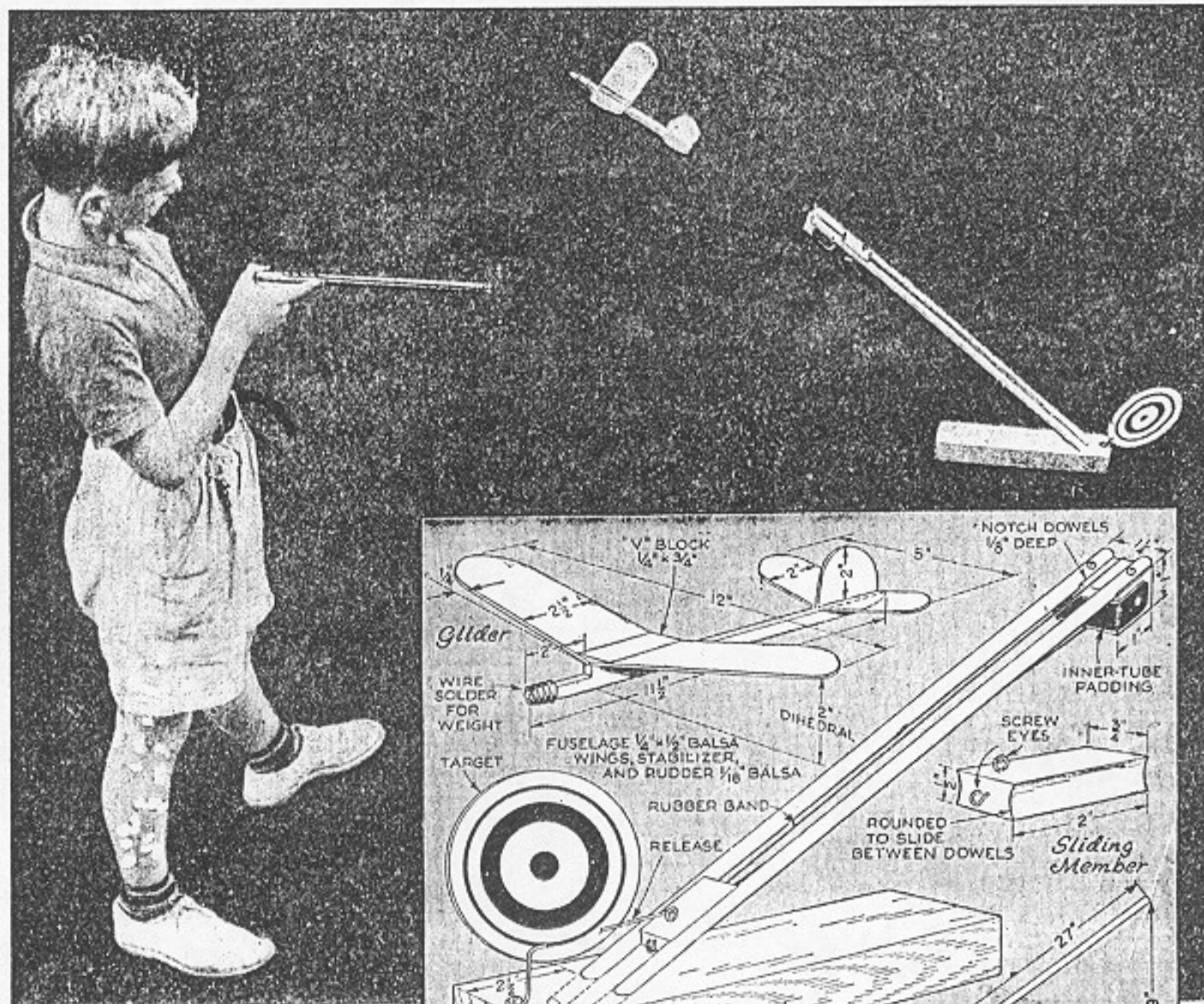
Next step in Doe's division goes the same way: 12 into 85, now the first two figures in the dividend. It goes seven times. So he enters 7 in the quotient, and moves indicator over it. Then he subtracts 84 (7×12) from the 85. This leaves 1. So the three figures now remaining in the dividend, as shown below, are 156.



Toy Antiaircraft Gun

LAUNCHES GLIDER, THEN SHOOTS IT DOWN

GIANT HOME WORKSHOP MANUAL 1943



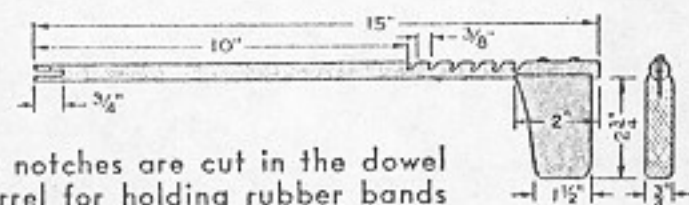
CATAPULTED into the air when the stationary target of this shooting game is hit, a small glider flies up to provide a moving target for the remaining shots on the six-round rubber-band gun. Novel as this game is, it can be easily constructed from scrap materials and will furnish many hours of enjoyment for children.

The catapult is built of two dowel rods set at an angle in a wood base. A cardboard target, wired as shown, releases a sliding member that launches the glider. The small stop block at the top of the catapult is padded with rubber strips.

A dowel attached to a convenient handle forms the gun. A slot at the front and several notches near the handle hold the rubber-band ammunition under tension. The

gun is operated by sliding the rubber bands out of the notches with the index finger. A little practice will soon teach the secret of rapid operation. Aluminum foil is wrapped around one end of the rubber bands to give the bands sufficient firing power.

Any small, simple glider may be used, or one may be built of balsa wood as shown. The front end of the glider must be rounded so that it slides over the end of the catapult.

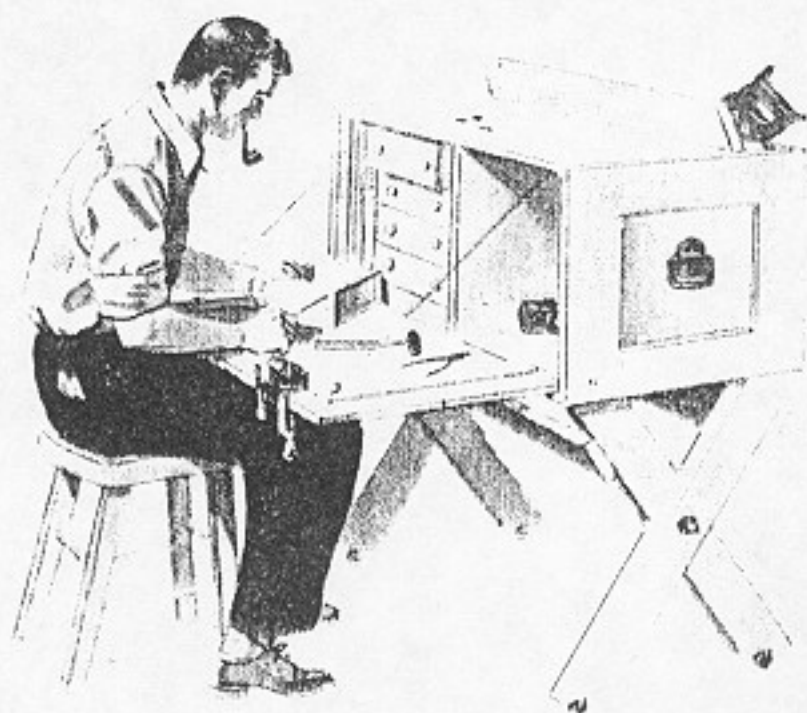


Six notches are cut in the dowel barrel for holding rubber bands

Popular Mechanics Jan. 1952

Apartment WORKSHOP

By Joseph Whitehill

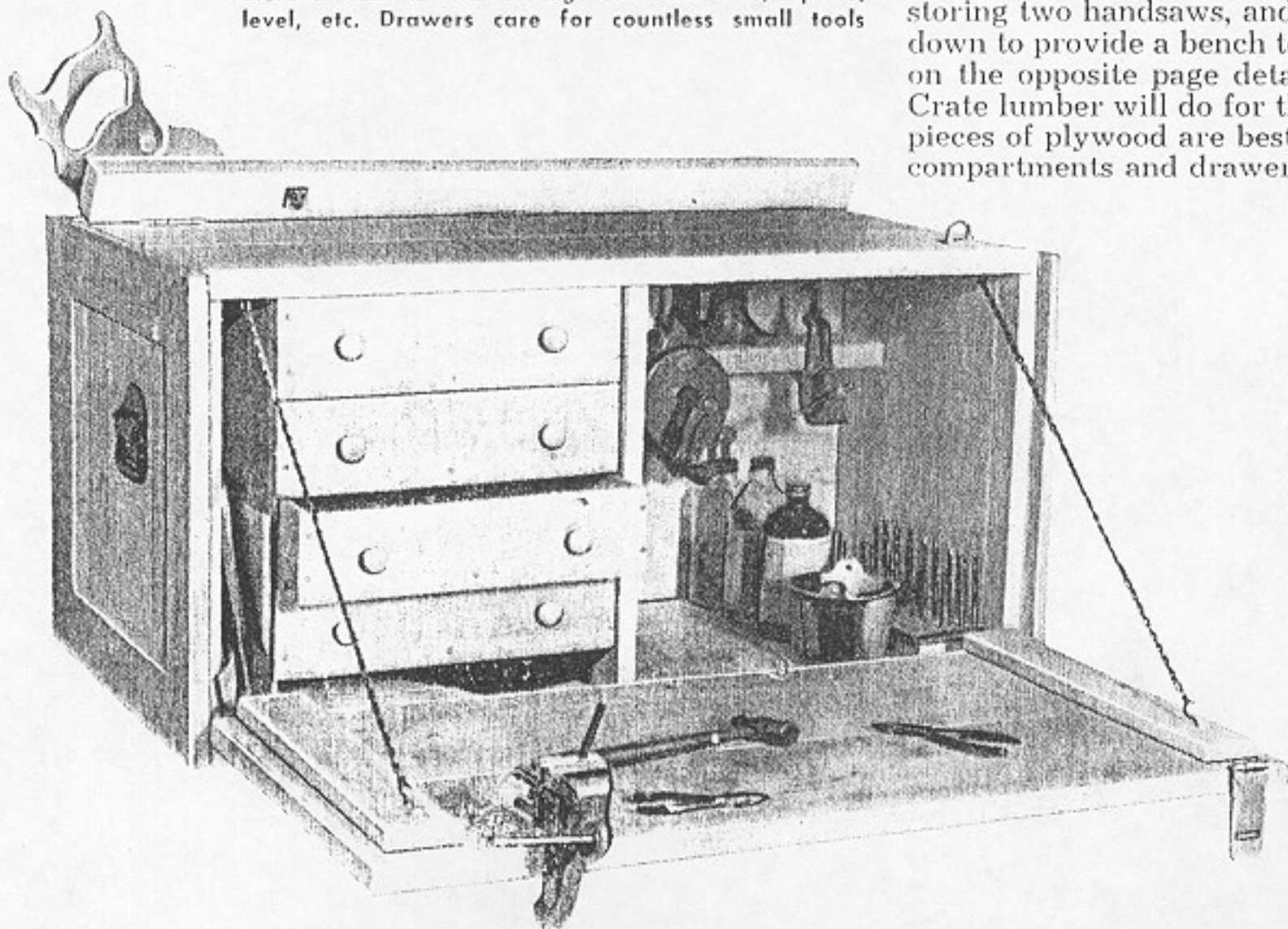


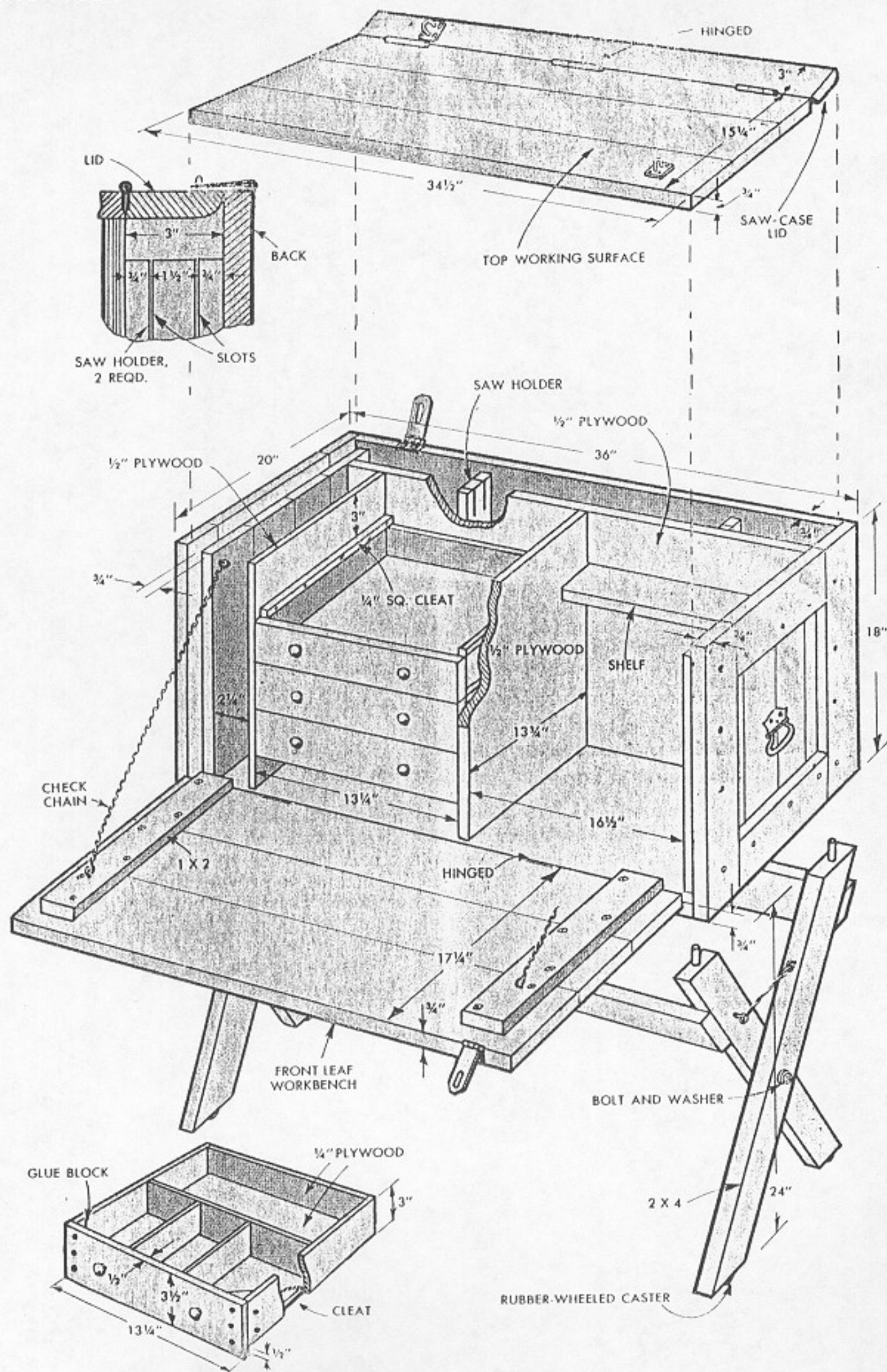
You literally "set up shop" when you roll out this compact little workshop. Combining a chest and bench in one, it's the answer to the apartment "crafter's" prayer for a convenient place to work and store tools.

Chain-supported drop lid lowers to form a handy lap-type bench top when chest is open. Compartment at rear affords storage for handsaws, square, level, etc. Drawers care for countless small tools.

DOES THE kitchen table serve as your workbench, much to the annoyance of your wife? If so, this article is especially for you. It shows how you can have a workbench and tool chest all in one within the confines of a compact trunklike box. Supported by a folding detachable sawbuck stand, both parts of this workshop can be stored in a minimum of space. It's the perfect setup for the man who resides in an apartment, or the owner of a basementless house who likes to tinker, build models or keep the household appliances in repair. Everything is at hand when you want to "set up shop" and, when you're through, tools can be quickly packed away for another day. It's as simple as that.

The photo below shows how the box is divided into compartments and fitted with four drawers for regimenting small tools, parts and materials. Features of the box are a separate compartment at the back for storing two handsaws, and a lid that drops down to provide a bench top. The drawing on the opposite page details construction. Crate lumber will do for the box, although pieces of plywood are best for forming the compartments and drawers.

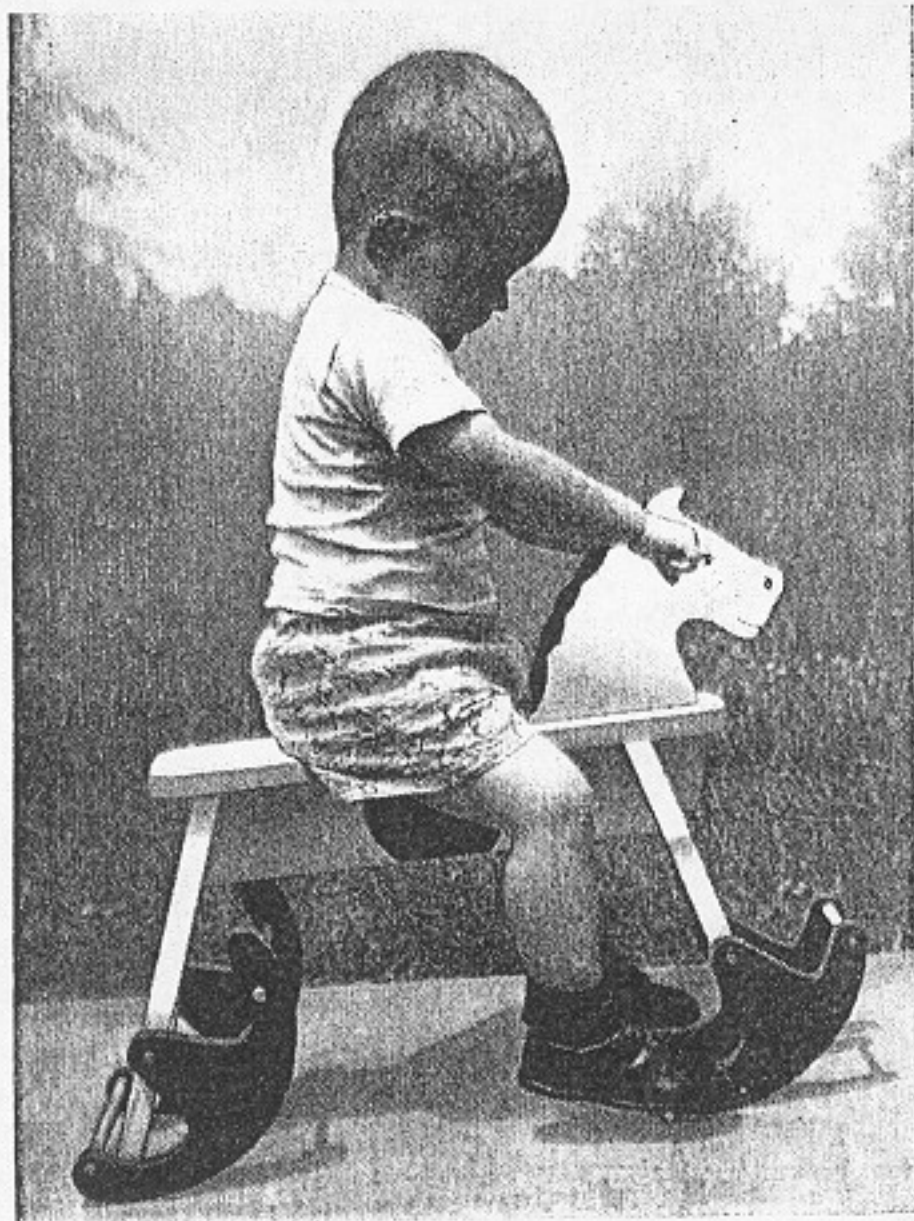




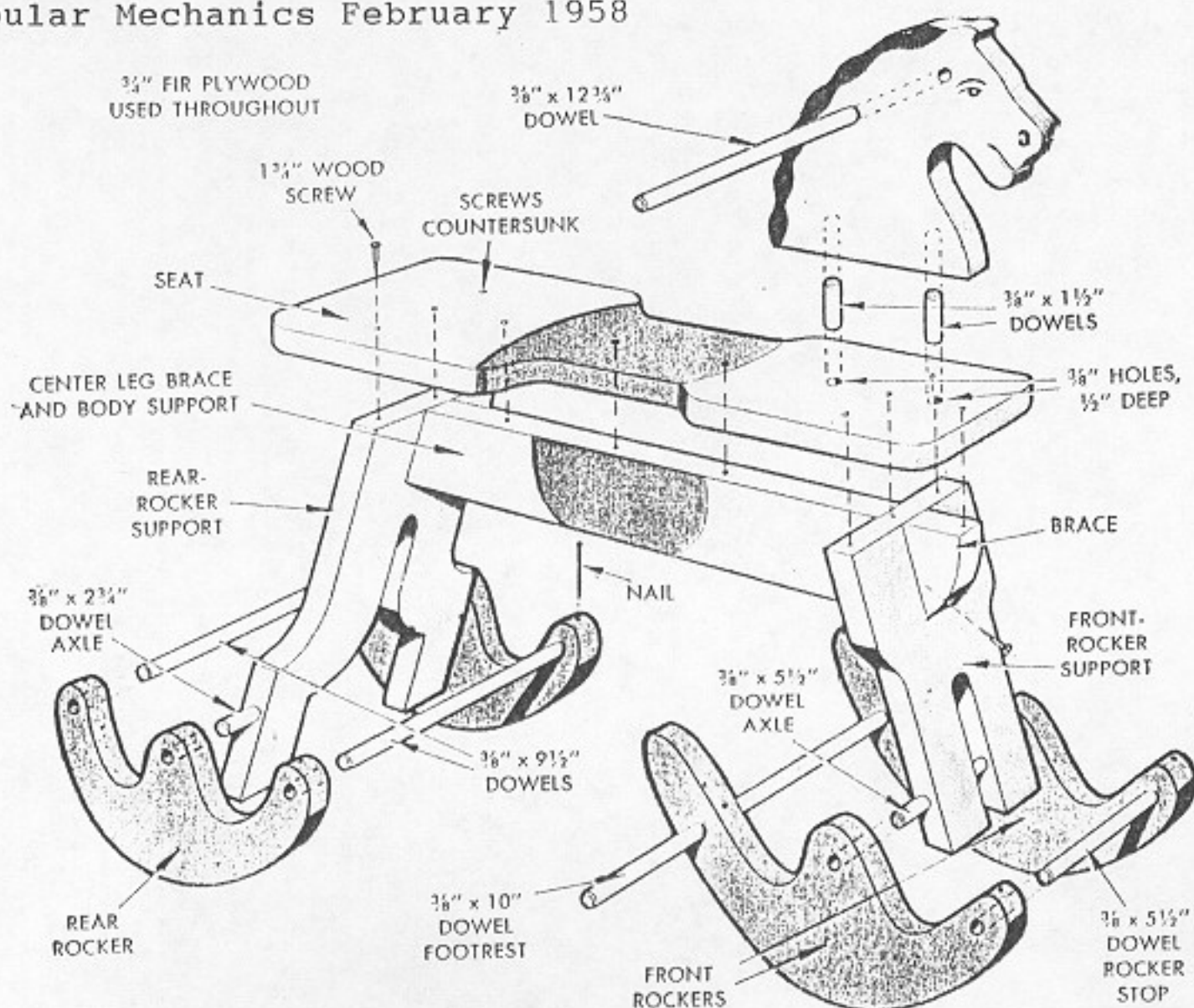
STAY-LEVEL

By G. E. Hendrickson

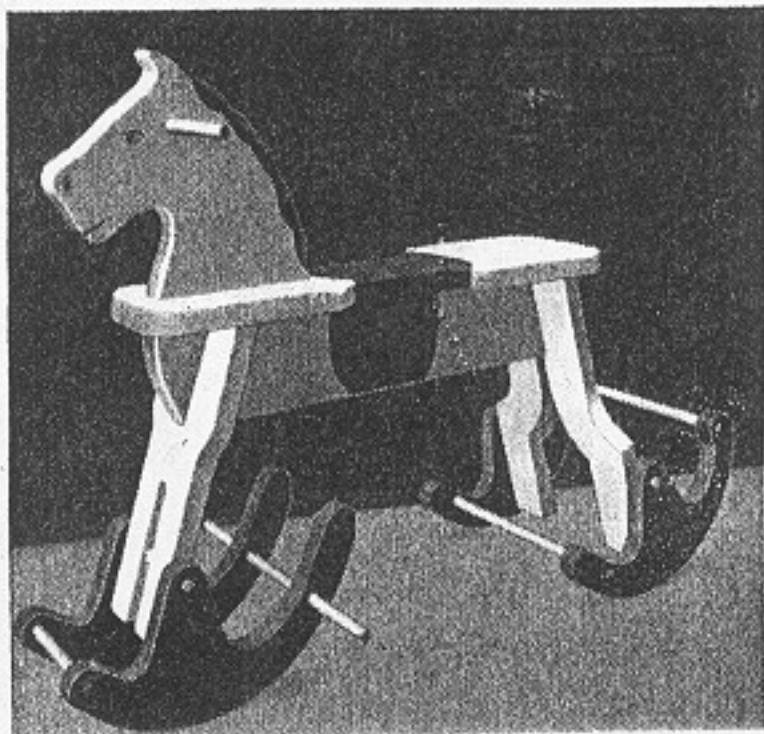
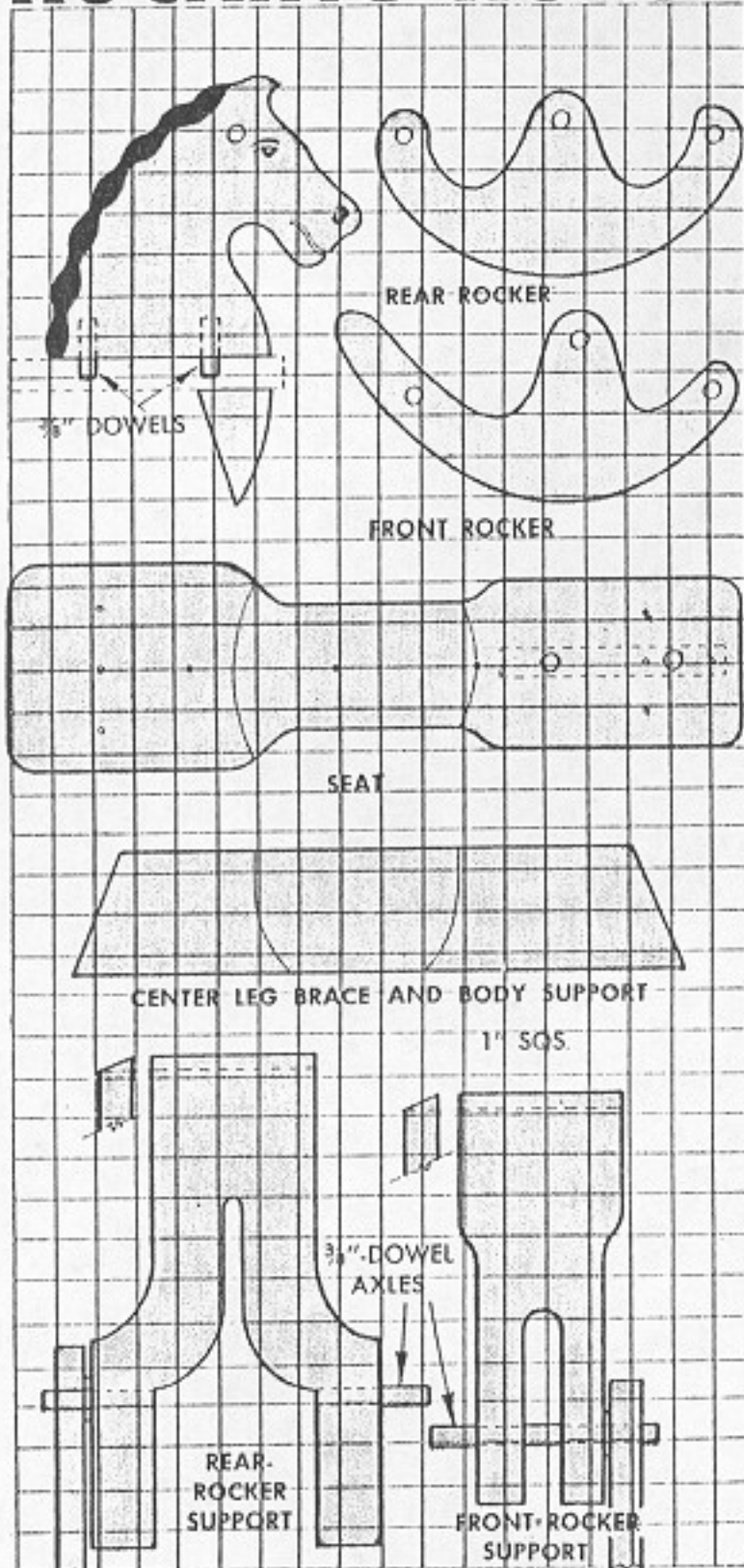
EVEN THE YOUNGEST rider is in no danger of having this rocking horse throw him. The reason is that the two sets of rockers are so positioned that the body of the horse remains level at full gallop. Note how they are pivoted in much the same manner as a porch glider. All parts for the horse, including the rockers, can be cut from $\frac{3}{4}$ -in. plywood, following the squared patterns on the facing page. Axles and rocker stops are lengths of $\frac{3}{8}$ -in. dowel. The stops are an added feature that limits the length of swing of the rockers, and also prevents the rockers from being inverted when the horse is dragged about by its youthful owners. On the front set of rockers, the rear stop is allowed to project about 3 in. outside each rocker to provide footrests for the rider, and also as a means of "driving" the horse. ★ ★ ★



Popular Mechanics February 1958



ROCKING HORSE



“CHILDREN MUST BE PAID FOR.”

Harper's New Monthly Magazine — Sept. 1852

SWEET is the sound of infant voice;
Young innocence is full of charms;
There's not a pleasure half so choice,
As tossing up a child in arms.
Babyhood is a blessed state,
Felicity expressly made for;
But still, on earth it is our fate,
That even “Children must be paid for.”

If in an omnibus we ride,
It is a beauteous sight to see,
When full the vehicle inside,
Age taking childhood on its knee.
But in the dog-days' scorching heat,
When a slight breath of air is pray'd for,
Half suffocated in our seat,
We feel that “Children must be paid for.”

There is about the sports of youth
A charm that reaches every heart,
Marbles or tops are games of truth,
The bat plays no deceiver's part.

But if we hear a sudden crash,
No explanation need be staid for,
We know there's something gone to smash;
We feel that “Children must be paid for.”

How exquisite the infant's grace,
When, clambering upon the knee,
The cherub, smiling, takes his place
Upon his mother's lap at tea;
Perchance the beverage flows o'er,
And leaves a stain there is no aid for,
On carpet, dress, or chair. Once more
We feel that “Children must be paid for.”

Presiding at the festive board,
With many faces laughing round,
Dull melancholy is ignored
While mirth and jollity abound:
We see our table amply spread
With knives and forks a dozen laid for;
Then pause to think:—“How are they fed?”
Yes, “Children must indeed be paid for!”



Although ceramics, or pottery making, is one of the oldest of the arts, hobbyists still can turn a neat profit from custom work in their own original designs. Anyone can build the necessary equipment at small initial cost

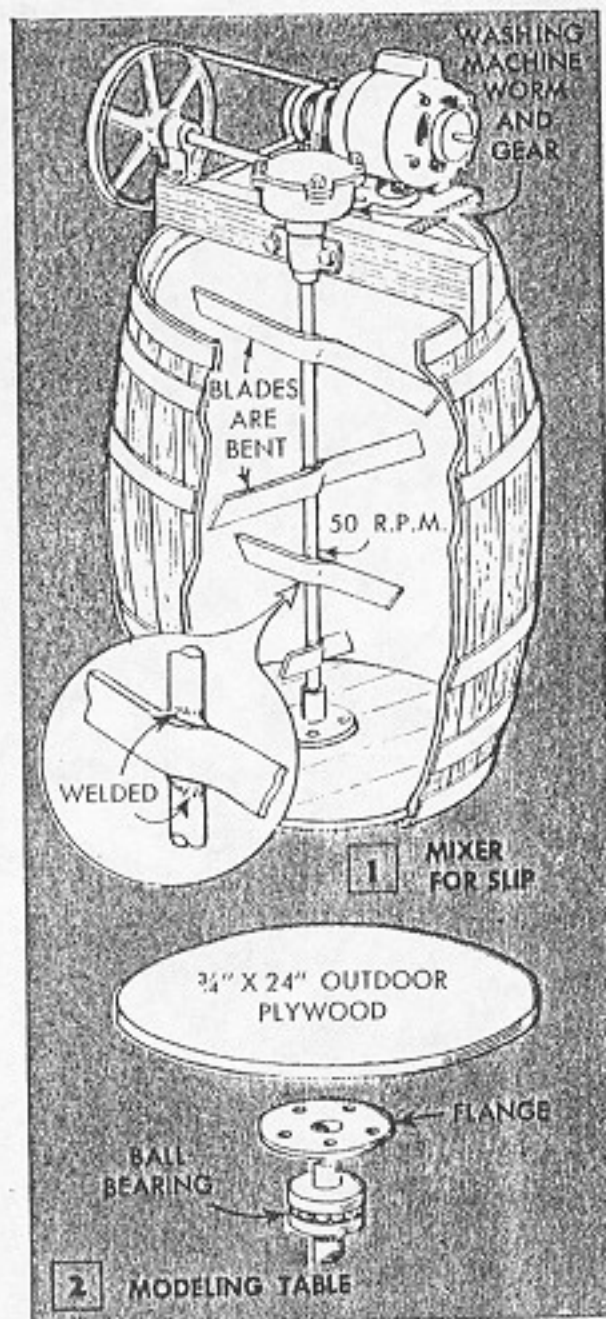
Popular Mechanics September 1948

CERAMICS *By Hi Sibley*

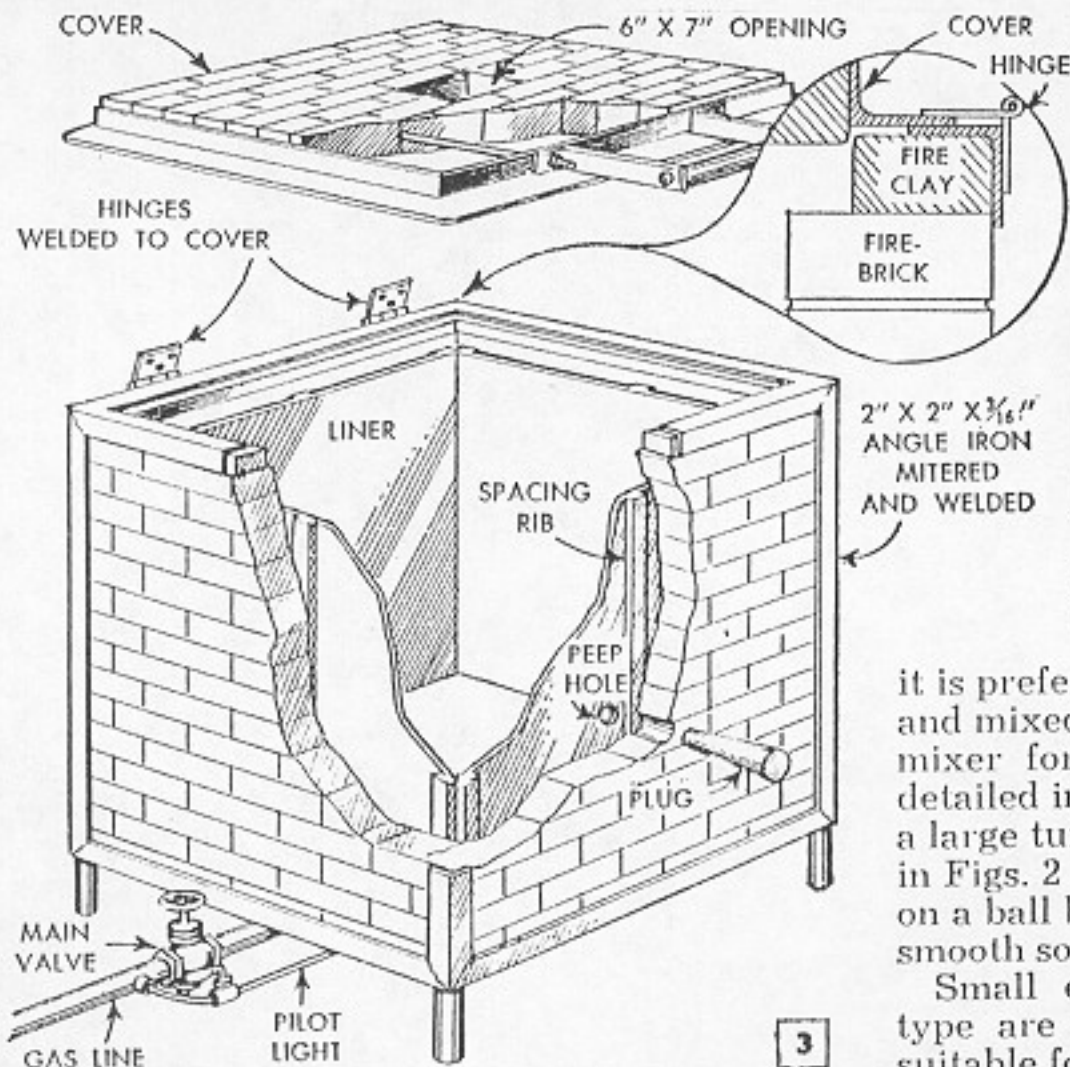
AS OUTLINED by Miss Jane Poyer, nationally known authority on ceramic sculpture, there are two methods of making pottery. One method is casting in plaster molds and the other is turning or throwing on a potter's wheel. The former process permits a great variety of design ranging from a simple dish to intricate groups of figures. Also, there are many minor variations of both processes. In casting, a clay model of the subject is first made and plaster of paris is poured over it to form a two-part mold. For the more intricate shapes the mold is often made in several parts. When the plaster has set, the mold is opened and the model removed. The mold is again assembled and is filled with liquid clay, or slip. When this has set or solidified sufficiently to hold its shape, the mold is again opened and the clay casting removed. Rough edges are carefully scraped off and the entire surface of the casting is smoothed with a wet sponge. Then it is placed in a kiln for bisque or hard firing. Following this, color is applied with brush or spray, the piece is dipped in a glaze solution and is then glaze-fired in the kiln, giving it the glossy surface of the finished product. In the process of throwing on the potter's wheel, the object is shaped freehand without use of either a pattern or mold.

For general work in ceramics the hand tools required are spatulas, scrapers, a sharp-pointed knife, several soft brushes, a spray gun, and a mortar and pestle for mixing colors. If the firing is done in a home kiln, special kiln furniture will be needed such as shelves, shelf supports and saddles and stilts on which the work is supported while being fired.

Modeling clay can be purchased from dealers already prepared for use, or it may be prepared by the user from the raw clay. Liquid clay or slip also can be obtained from dealers, but if required in quantity,



An efficient mixer for slip is made from a hardwood barrel and a reduction gear from an old washing machine. At top of page, Miss Poyer, nationally known ceramics artist, with examples of her work

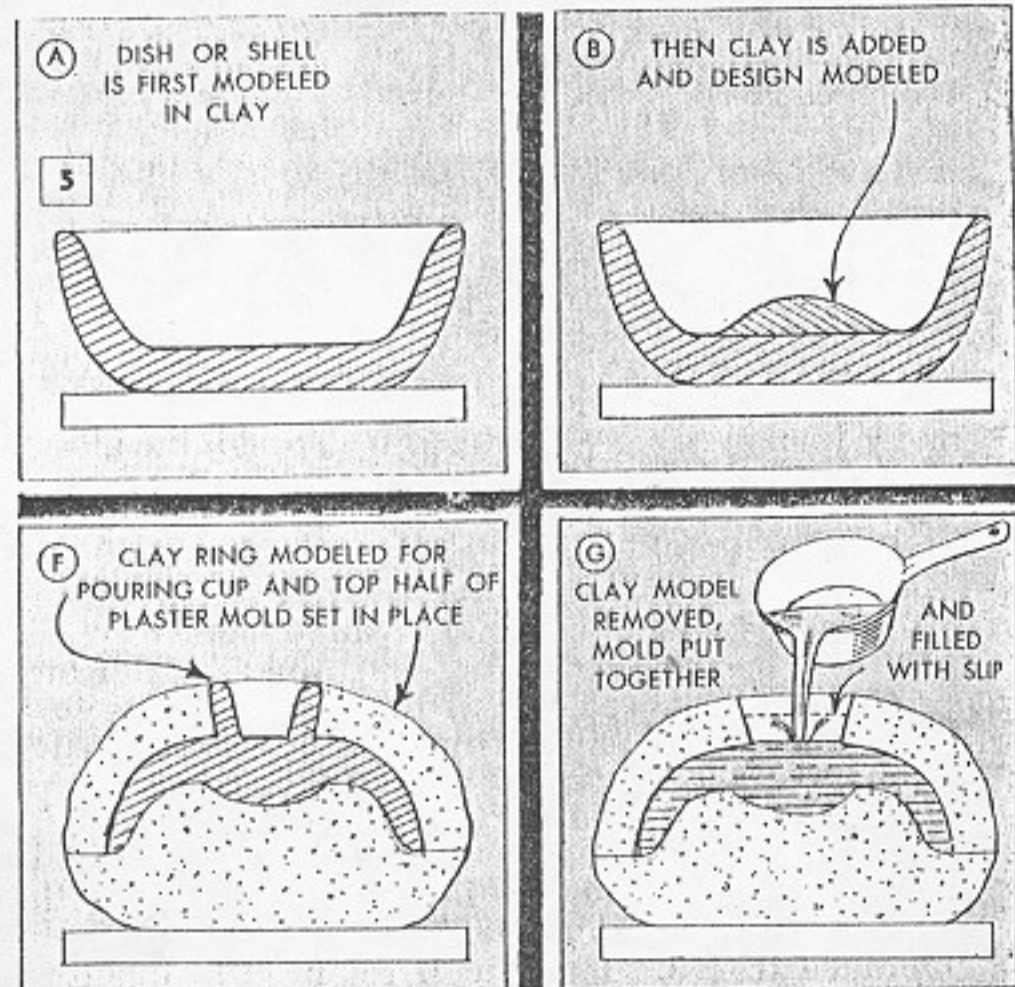
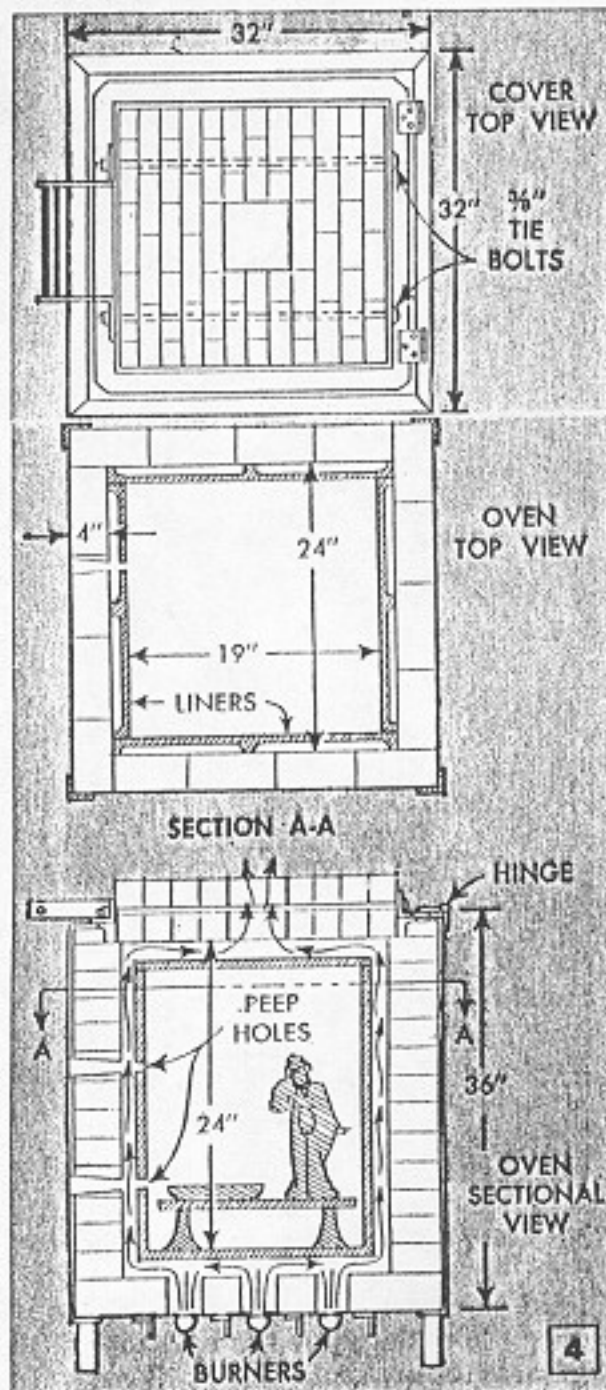


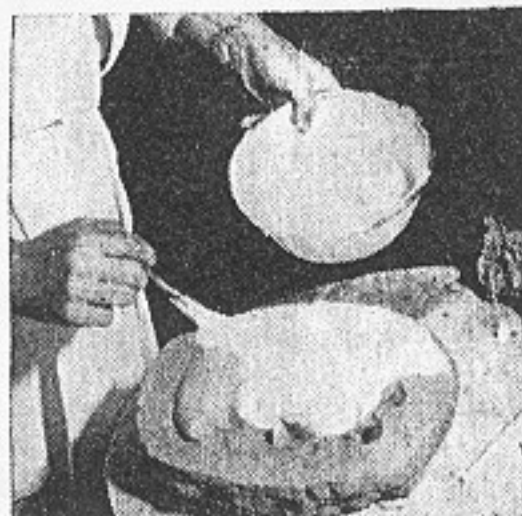
Wooden spatula is used to smooth clay after it is modeled to shape

it is preferably purchased as a powder and mixed as needed. A motor-driven mixer for large quantities of slip is detailed in Fig. 1. Modeling is done on a large turntable, such as that detailed in Figs. 2 and 6. The table is mounted on a ball bearing and its top should be smooth so that it can be cleaned easily.

Small electric kilns of the bench type are convenient to use and are suitable for firing small pieces. A gas-fired kiln, for commercial production, is detailed in Figs. 3 and 4. It consists of a firebrick shell set in a frame made from angle iron. An inner shell is formed from fire-clay liners and heat from the eight gas burners passes between the liner and the outer wall, and out the opening in the lid, Fig. 3.

The step-by-step process of making a piece of cast pottery is shown in details A to J inclusive, Fig. 5. First, the modeling clay is kneaded on a plaster-of-paris slab, or batt, and the piece, designed in sea-





Plaster is brushed on lower half of mold. Coating must be uniform



Clay ring makes pouring cup on bottom of shell. Ring is removed

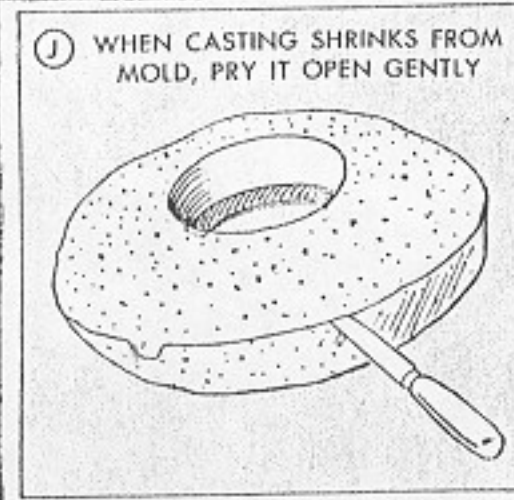
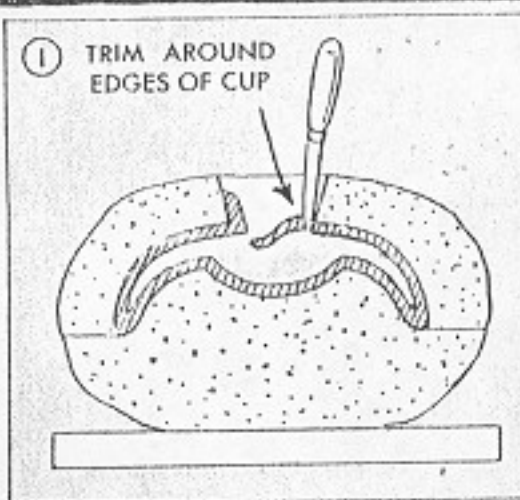
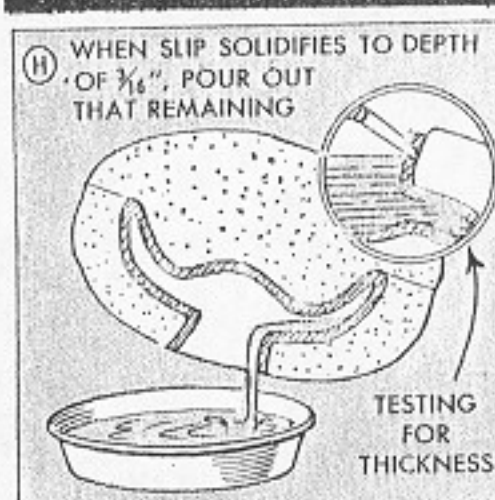
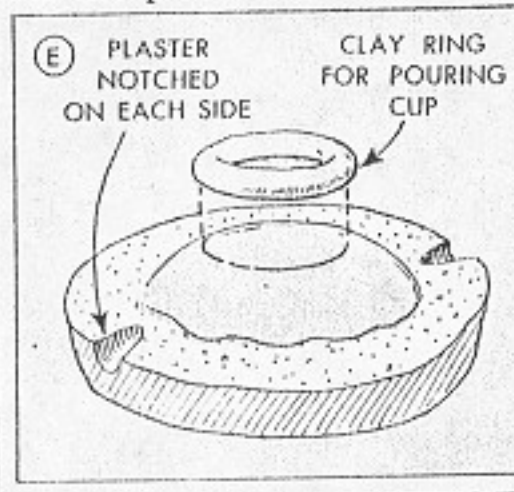
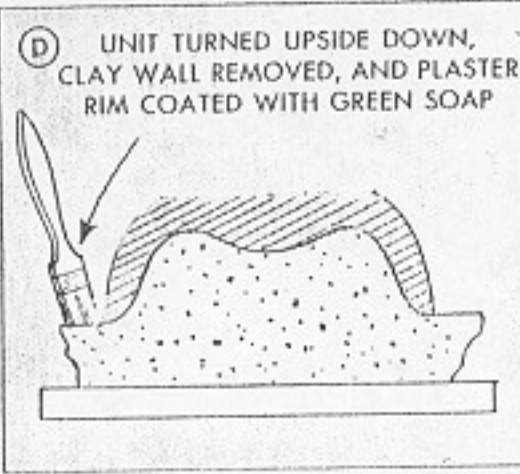
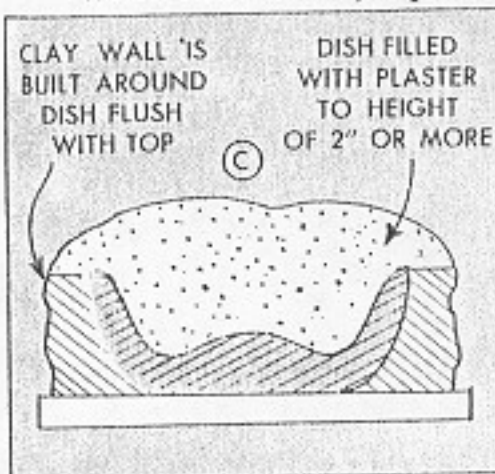


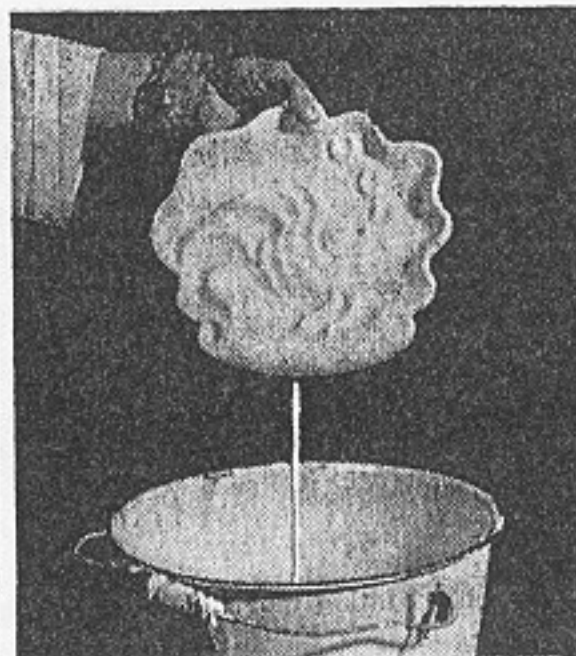
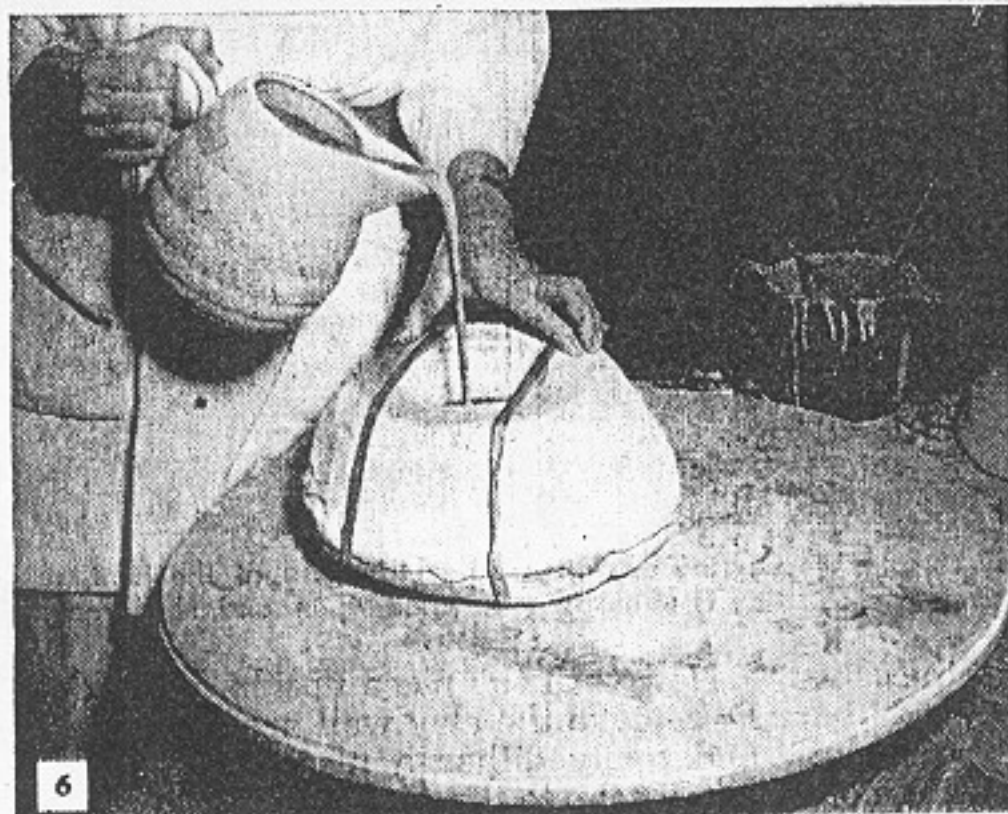
After trimming at the joint, mold is pried open and shell removed

shell motif with a fish ornament at the center, is roughly shaped with the hands on the turntable to the sectional shape shown at A. Then, a clay roll is added to the bottom from which the fish is to be modeled. Both shell and fish are gradually molded into shape with the fingers, which are kept moist with a sponge. Wooden spatulas and wire cutting tools are used in the finish modeling of both parts. Plaster of paris is brushed over the surface and a clay wall is built around and under the shell and brought up flush with the rim. Then build up the plaster on the model until about 2 in. thick, detail C, as a thinner mold will not absorb moisture sufficiently to dry the casting properly. In preparing plaster of paris, pour the dry powder into a basin of water until an island is formed. When this absorbs the water and begins to settle, mix with the hands, squeezing out the lumps.

Now turn the piece upside down, detail D, remove the clay wall around the shell, and apply either a plaster separator or green soap to the rim of the plaster so that the fresh plaster of the other half of the mold will not adhere. Notch the edges on opposite sides so that the two halves can be fitted together again in exact register. Make a clay ring and place it on the bottom of the model, detail E. This is formed into a pouring cup.

Build up the second half of the plaster mold as in detail F. When it has hardened, trim around the joint with a knife and carefully pry the mold open. Remove the clay model or pattern, clean the mold and put it together again. The halves are held in place with strong rubber bands, Fig. 6. Slip is now poured in as in detail G until it fills the mold nearly to the top of the pouring cup. As the plaster mold absorbs

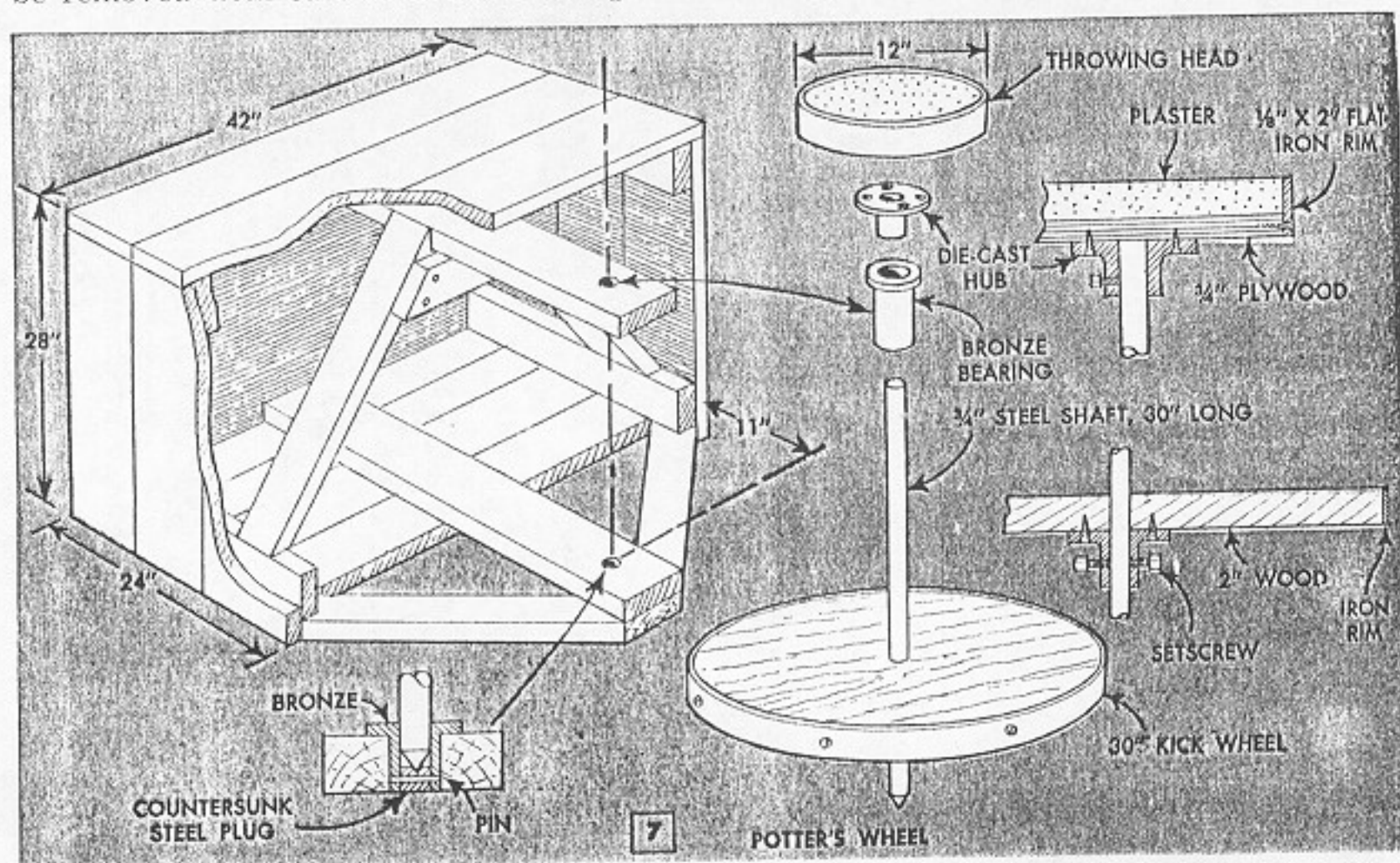


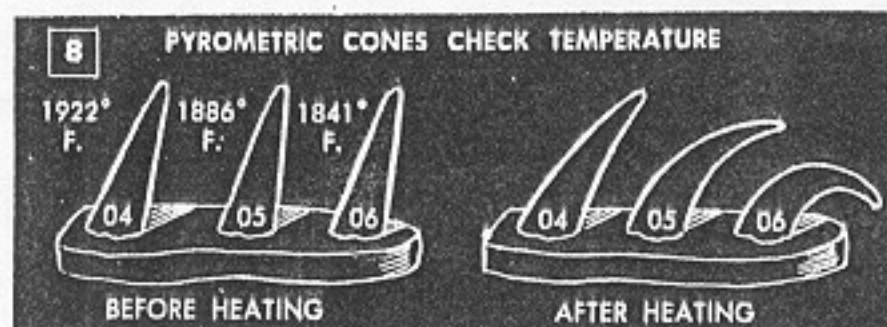


Left, mold is assembled and slip is poured in. Above, after bisque firing and coloring, piece is dipped in glaze

water rapidly, the slip in contact with it will solidify and the level of the slip in the cup will recede. After it has gone down $\frac{1}{4}$ in. or so, make a knife cut near the top, detail H, to test for thickness and when the solidified slip is from $\frac{1}{8}$ to $\frac{1}{4}$ in. thick, invert the mold and pour out the unsolidified slip. Now carefully trim around the edges of the cup, as in detail I, so that the mold can be opened without breaking the shell-like casting, which shrinks away from the mold sufficiently so that removal will be comparatively easy when the mold is opened. Castings with thin edges should be removed with care to avoid breakage.

Finally pry the mold open with a knife blade and lift out the casting very carefully. Scrape off any fins and smooth the piece with a damp sponge. It is now ready for bisque or hard firing and is placed in the kiln on stilts to raise it off the floor. Pyrometric cones, Fig. 8 are placed just opposite the peephole. These are numbered for various temperatures and the cone marked 04 is used for bisque as it bends or "wilts" at 1922 deg. F. The cone becomes red hot and is easily seen in the dark interior of the kiln through the peephole. When it begins to bend, the heat is turned off. Length of firing time depends on the



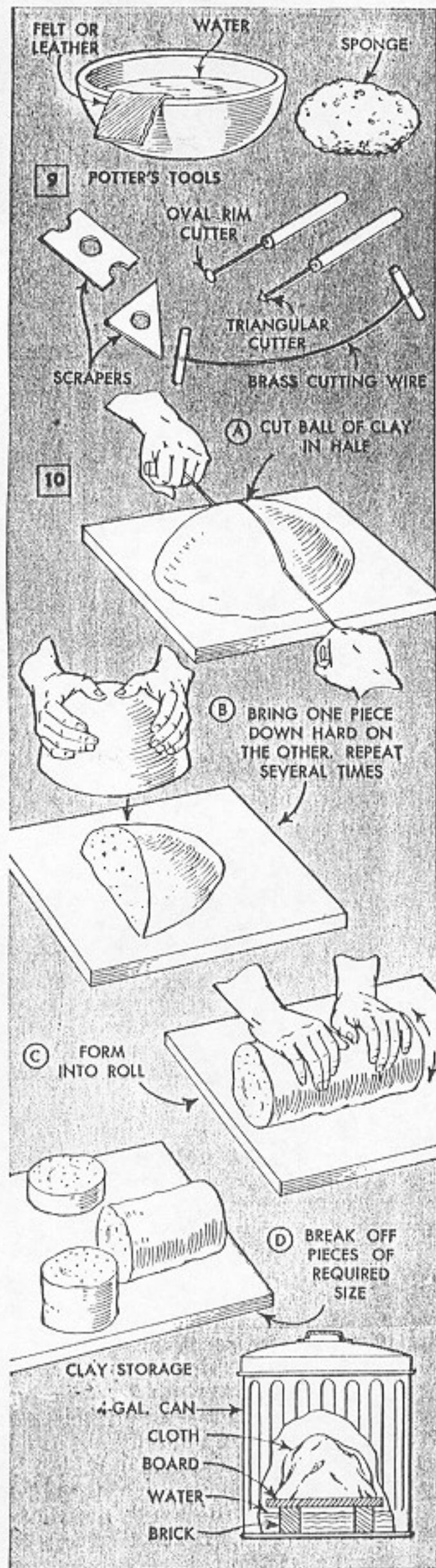


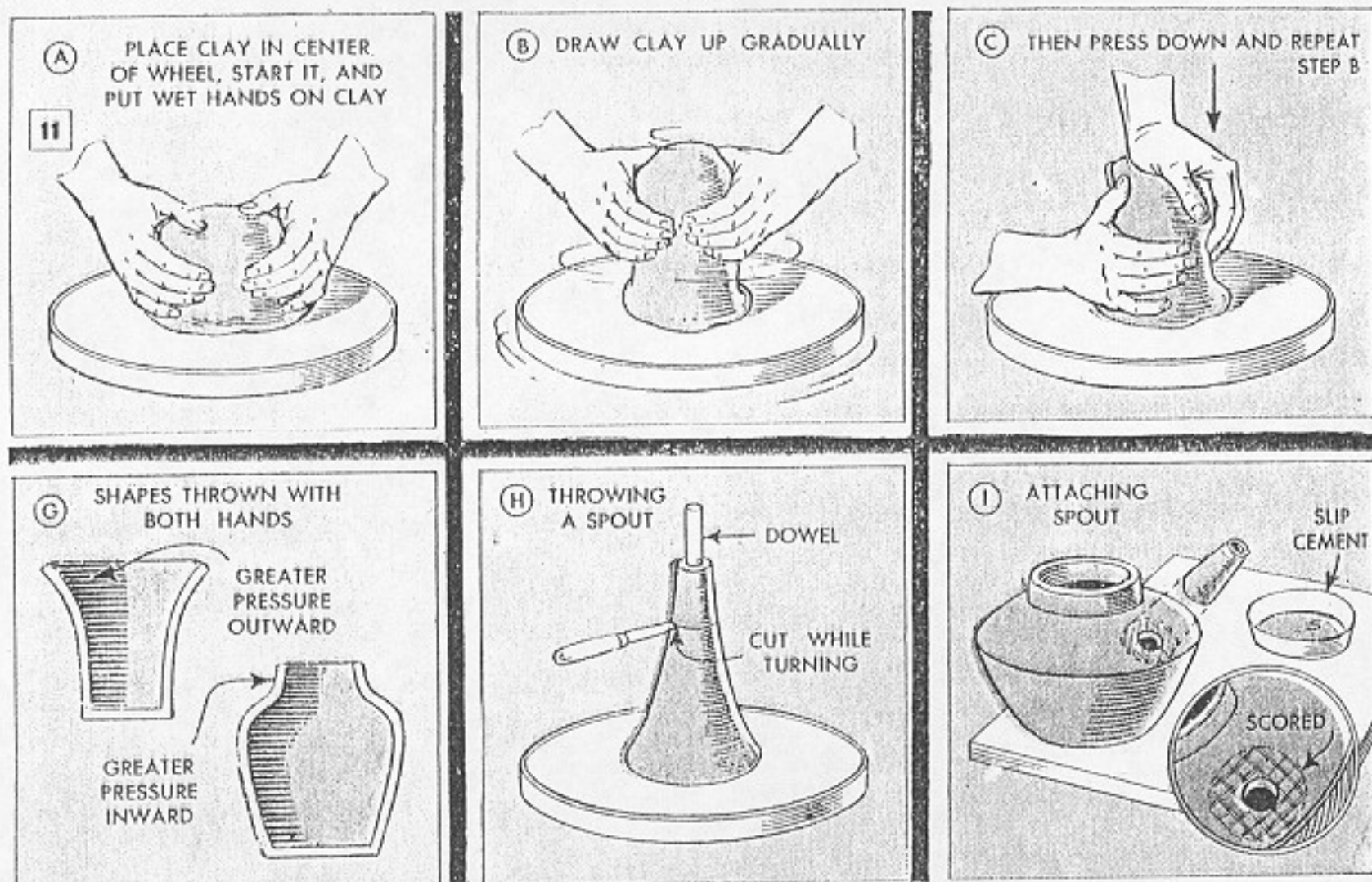
gas pressure, the type of kiln used and other factors. In regular practice, the heat is turned on at lowest adjustment for two hours or so to warm the kiln. Then it is turned up full. Four to eight hours at full heat are required in hard firing.

Coloring with engobe, or colored slip, is the next step. The colored engobe comes in dry form and is prepared according to the directions supplied. Engobe is laid on in a uniform coating but is not brushed out like paint. It will appear flat and colorless before firing, but the application of heat brings out the true color. Colors also are applied with a spray gun. After coloring, the glaze solution is applied, either by spraying or dipping. In dipping, the piece is immersed in the solution, and the portions held by the fingers are later painted over with the solution. The piece is now placed in the kiln and fired for about an hour to set the glaze and impart a glossy finish.

In its simplest form the potter's wheel consists of a rotating disk propelled by means of a kick wheel. A refinement is the electrically driven wheel with variable speeds. A simple design employing the kick wheel is shown in Fig. 7. Essential features are a strongly braced frame, with an easy-turning kick wheel and throwing head, or disk, upon which the subject is modeled. Distance between top of bench and kick wheel either should be adjustable or fixed at the most convenient and comfortable height for the operator, who straddles the shaft and rotates the wheel by a forward motion with the right foot and backward with the left, the motion being from the knees downward. Construction details are shown in Fig. 7, 2-in. material being used throughout to make a rigid structure. The two shaft bearings are flanged bronze sleeves, the lower one having a countersunk plug of brass or cast iron on which the shaft rotates. Ordinarily, the kick wheel is made from wood with a heavy iron rim, or tire, to give the effect of a flywheel. For the throwing head, many potters prefer a plaster surface as the clay adheres well and surplus moisture is absorbed. This type is made with an outdoor-plywood bottom fitted with a sheet-metal rim. When assembled the head is filled to the top of the rim with plaster of paris. Both disk and kick wheel are fastened to the shaft with flanges, the lower one being adjustable by means of setscrews.

Other necessary equipment is illustrated in Fig. 9. The bowl of water always contains a piece of leather or felt for smoothing clay on the wheel. The other items are a sponge, cloth, two brass scrapers, an oval and a triangular rim cutter,





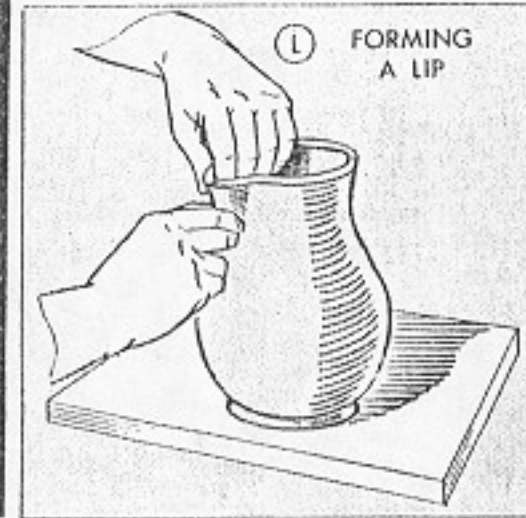
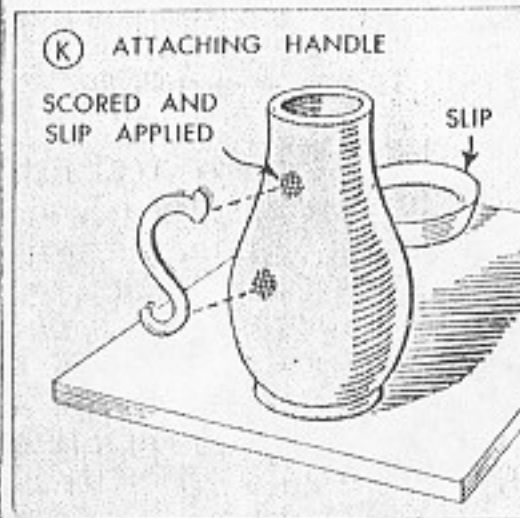
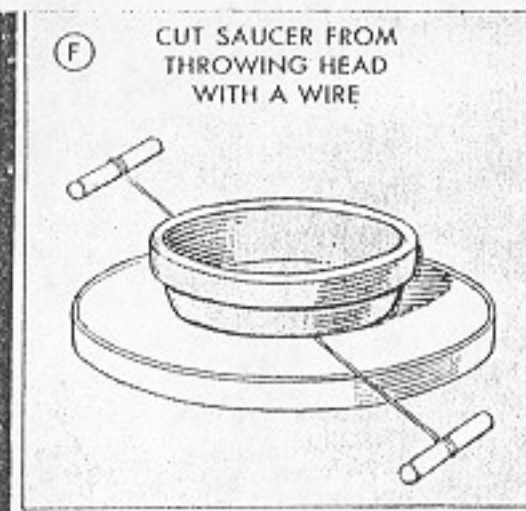
and a brass cutting wire with two wooden handles. Some potters prefer to dig and prepare the clay themselves. Others purchase refined clay from dealers to save time and labor. Clay freshly dug from the pit should be seasoned through the winter. Then, the clay is powdered and mixed with water until it is thin enough to pass through a fine sieve into a large container. It is allowed to settle for several days, then the excess water is poured off. When dry enough to handle, spread it on a clean floor and allow to dry until stiff enough to knead. This can be done by hand, with the bare feet or in a pugmill. Further seasoning in a cool, damp place will improve its quality. Unused clay is kept in a covered can with about 2 in. of water in the bottom. The clay is placed on a board supported above the water on bricks. A cloth is then thrown over the mass, with the ends in the water.

Fig. 10, details A to D inclusive, shows how to prepare clay for the wheel. Work it into a ball the size of a round loaf of bread and place on a clean board. Cut in half with the brass wire, A. Then pick up one piece and bring it down hard on the other as at B. This is known as wedging. Repeat several times, finally forming the mass into a roll, C. Break off pieces of the sizes required, D, and mold them into balls.

In throwing a simple dish, a clay ball is placed firmly in the center of the throwing head, Fig. 11, and the hands are dipped in water. Start the wheel in motion and cup the hands over the clay, pressing down on

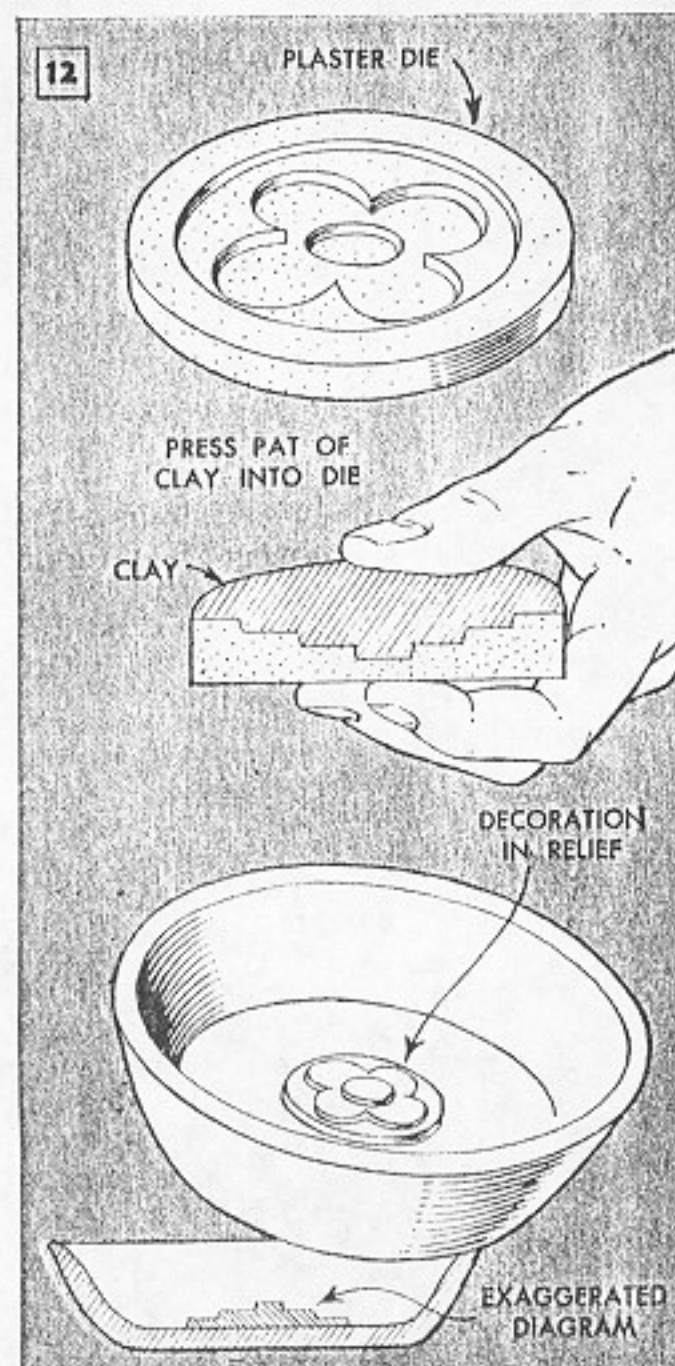
the disk, A. Now draw the clay upward with a slight pressure of the hands as at B, and then force it down again with the palm of the left hand. Repeat several times, detail C. This aids in conditioning the clay. Press both thumbs down in the center of the rotating mass to start a hollow, or depression. Widen this by inserting fingers of the left hand, D. Continue widening the hollow by using both hands, at the same time manipulating the rim with the fingers to bring it to the required thickness and height. Ridges are rubbed out with the fingers and a piece of wet felt, and the rim is smoothed with the square scraper, as in E. The knack of forming the clay into the various shapes is easily acquired after a little practice. Cutting the work from the throwing head is done as in detail F. When cutting work from the throwing head with the wire be sure to hold the wire taut as it may loop or kink and cause damage.

Throwing vases and jugs calls for much the same procedure, except that a larger ball of clay is used and the sides are drawn higher. Details G to L inclusive, Fig. 11, show the common technique quite clearly. For making the outward flare of a vase, simply exert greater pressure with the fingers of the left hand inside the rim than with the thumb of the same hand on the outside. The reverse movement shapes the curve in a jug, or teapot, as in G. The spout for a teapot is made by throwing a clay cone around a dowel and cutting it off at the required length with a knife while the



work is in motion, as at H. A hole is then cut in the pot the size of the dowel. The clay around the hole is scored and slip is applied, which acts as a cement when the spout is gently pressed against the pot, as in detail I. To make handles, start with a pear-shaped ball of clay, as in detail J. Hold the clay in the left hand, wet the right hand and gradually draw a long, conical shape. Then, without using any pressure from the thumb, draw out the shape with the fingers to the size required. The handle is bent to shape and the ends are flattened as shown in detail K. It is then attached to the pot with slip in the same manner as the spout. To form a pouring lip on a jug or vase, work with the index finger of the left hand inside and thumb and index finger of the right hand on the outside, as in detail L. Procedures in coloring, firing and glazing are the same as used when processing castings.

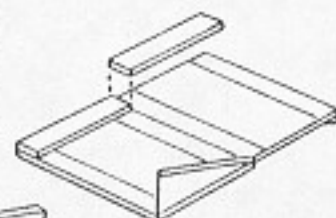
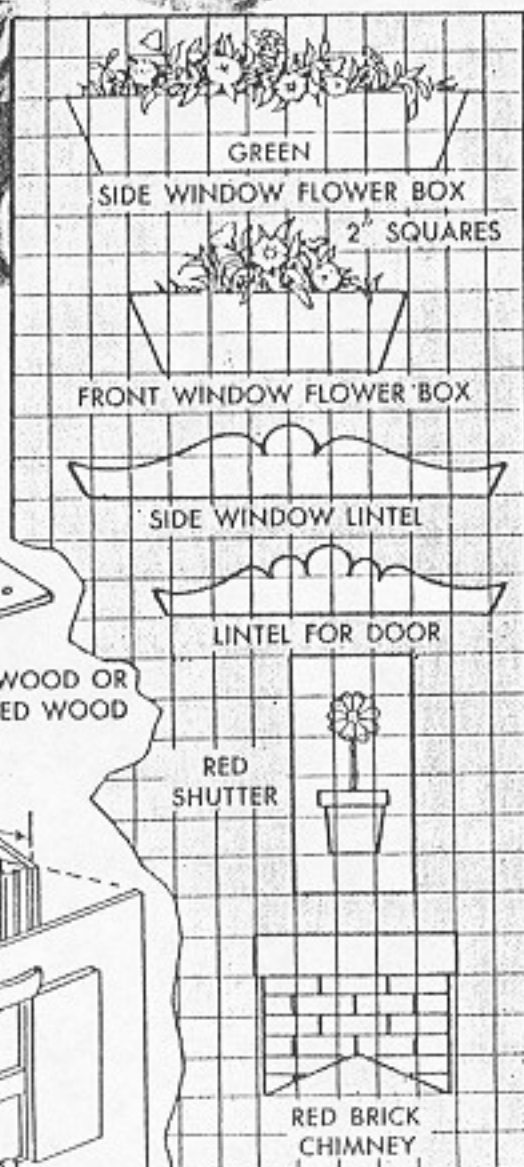
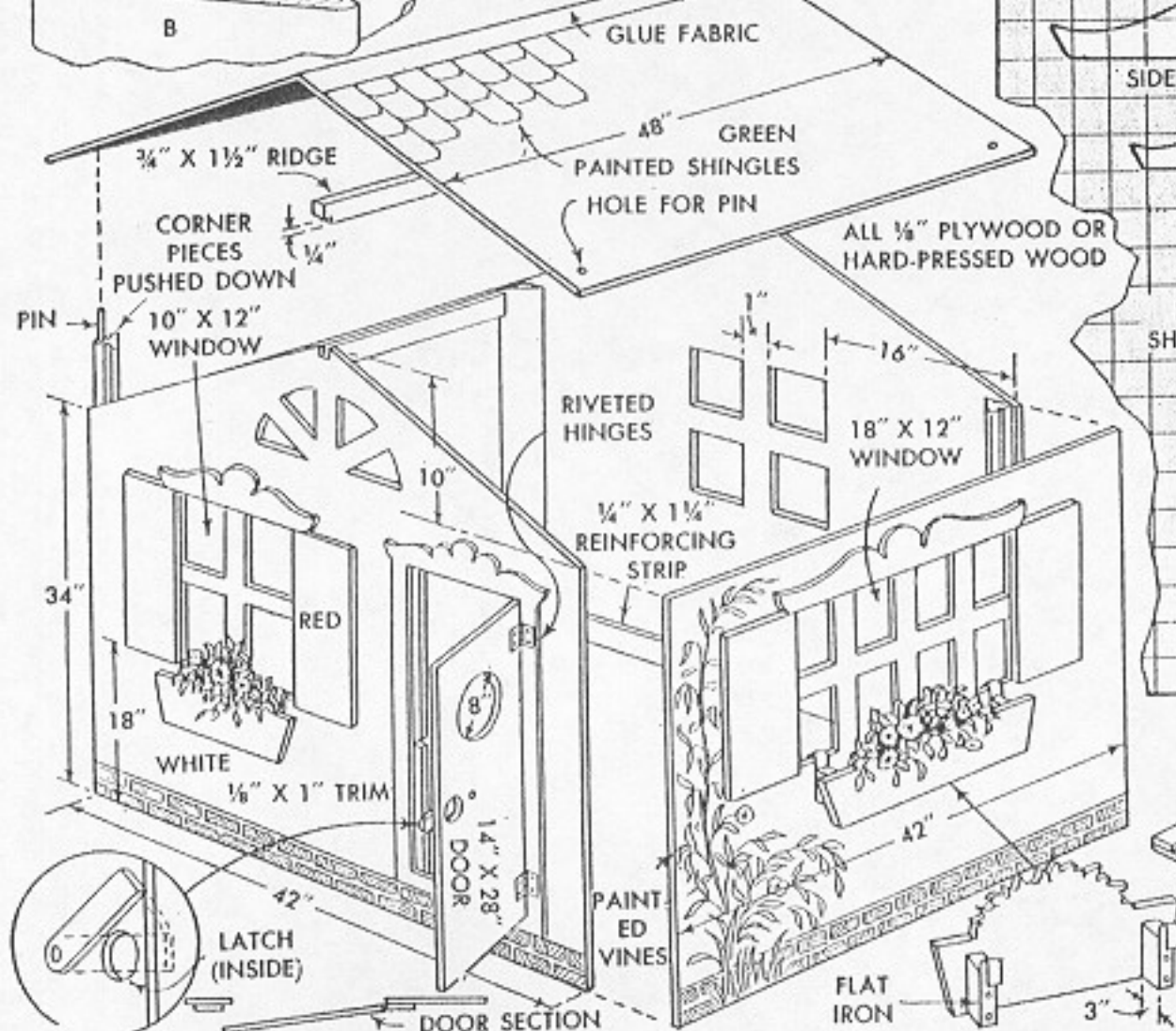
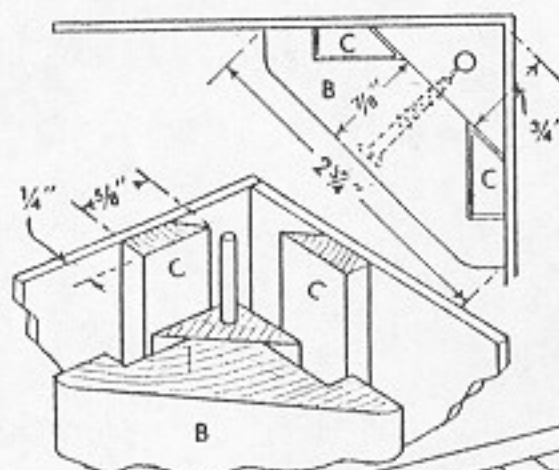
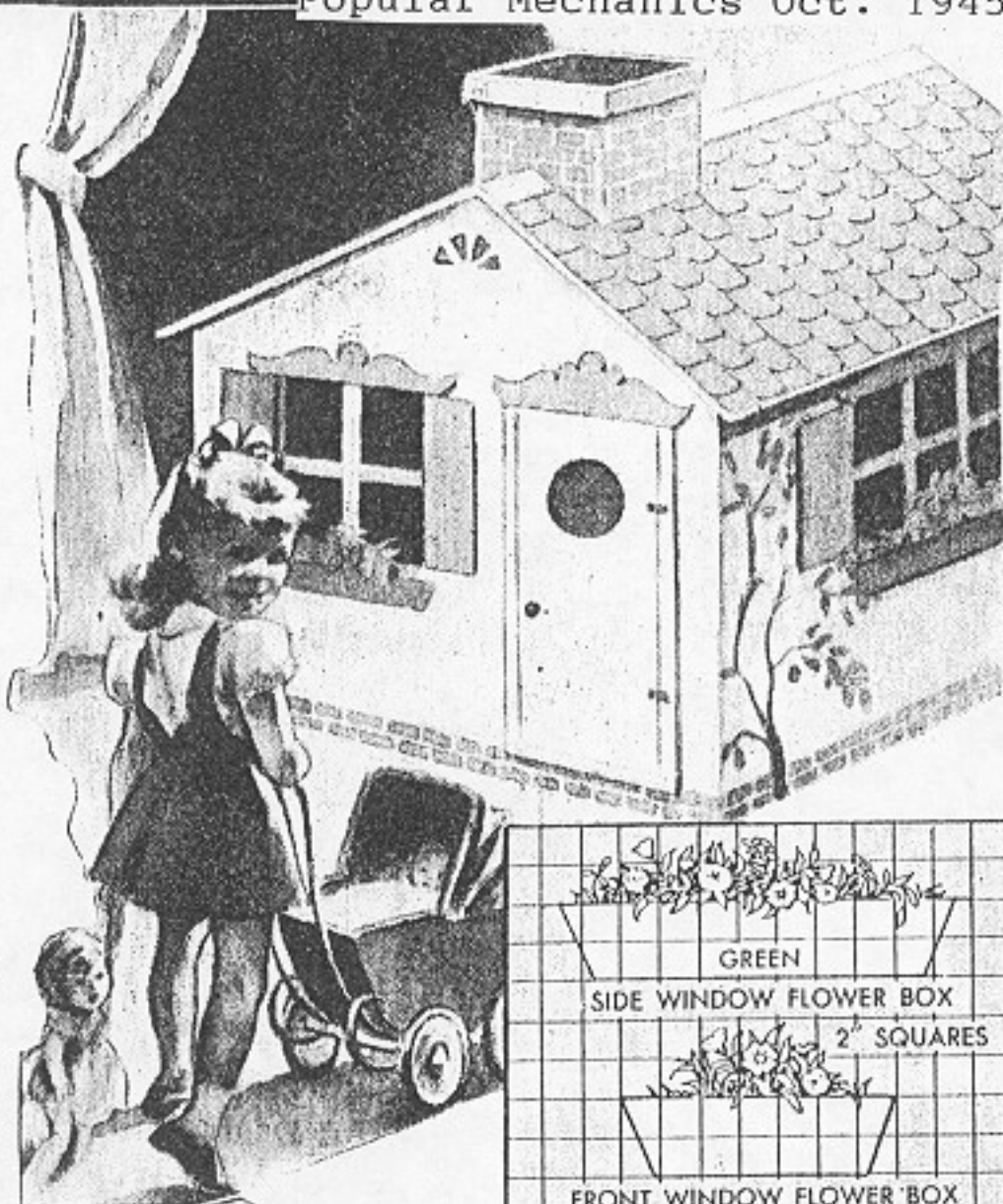
Overlay decorations are applied by means of plaster dies, Fig. 12. A pat of clay is pressed into the die, the excess scraped flush with a straight-edge, and the die with the clay in it is pressed against the surface of the work.



Build this Knock-down PLAYHOUSE

Popular Mechanics Oct. 1945

This trim little playhouse can be set up in 5 min. and when taken down may be stored in a small space such as a closet. The walls are assembled as shown in the upper left-hand detail. A triangular cornerpiece, to which part B is screwed, slides behind strips C, which are glued and nailed to the walls. The roof is supported by a ridge pole and held in place by pins projecting from the ends of the corner pieces. The chimney can be made of the same material as the walls. Two sides are notched to fit the roof angle and glued together. The door is held by a latch which is lifted through a fingerhole in the door. Gaily colored flowers are painted on window boxes and shutters, which are shown in the crosshatched pattern



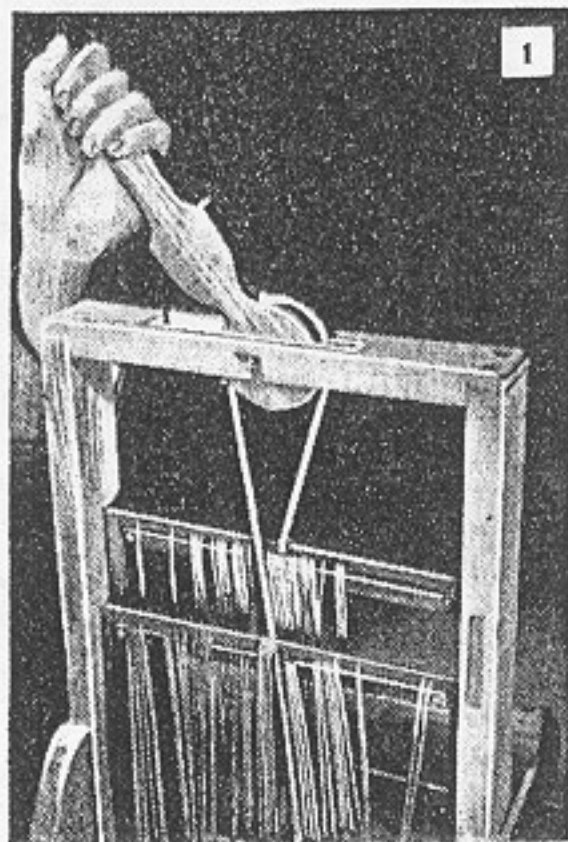
MAKE WEAVING



Many people have made weaving a profitable hobby with table-top looms like this one, which has several features to make the work easier and faster

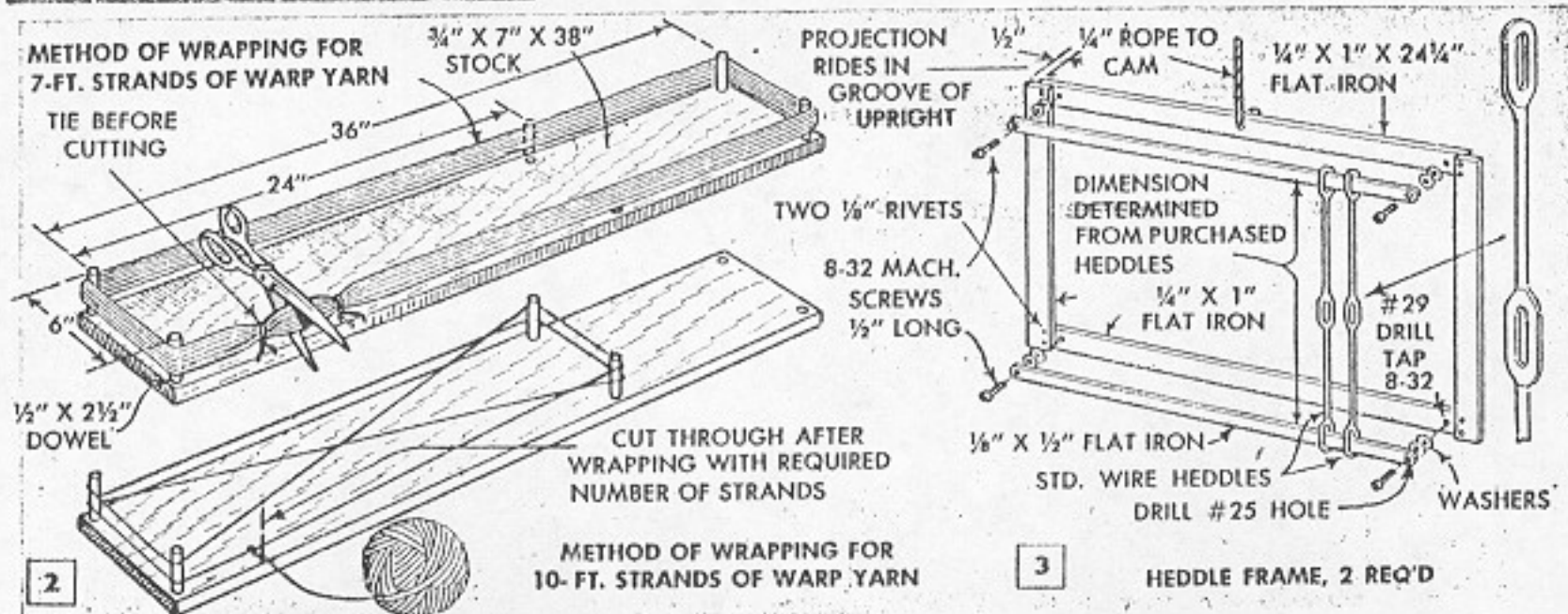
By
Stanley J. Drazek

POPULAR MECHANICS
JANUARY 1948



WEAVING scarves, table runners, scatter rugs in varied colors and similar articles is not only an interesting pastime for long winter evenings, but it also can be developed into a profitable hobby. Once you have mastered the technique with a little practice, you will be able to produce woven articles that will find ready sale at a good price.

With the loom pictured above, you can produce many salable articles. It consists of a frame which supports such moving parts as the warp and whip beams, heddles and frames, a reed or beater and a shuttle, the latter being a separate part which is manipulated by hand. The shuttle carries the weft thread through the shed, a triangular space between the warp threads which is made by shifting the heddles after each stroke, or pass, of the shuttle. The beater or reed, hand-operated on small looms, is pivoted to the frame of the loom and is for the purpose of beating the weft thread into the warp after the shuttle has passed through the shed. The table loom detailed in Fig. 4,



YOUR HOBBY

has two new features which make operation easier and faster. The heddles are shifted by a cam arrangement mounted on the top cross member of the frame and operated as in Fig. 1. Second important feature is the adjustable beater pivot detailed in Fig. 4. This adjustment gives five different positions of the beater pivot and enables the weaver to keep the reed always at 90 deg. with the cloth for more uniform work. A cloth beam fitted with a removable spline, Figs. 4 and 7, makes it unnecessary to tie knots in the warp threads when stringing the loom preparatory to weaving.

Before starting assembly, determine the size of the loom from the maximum width of cloth you desire to weave, keeping in mind, of course, the size limitations of the table-top type. As an example, the loom detailed in Fig. 4 is designed for a cloth width of 24 in. A smaller size also can be made with an over-all width of 16 in. for a cloth width of 12 in. This size is especially suited to weaving table runners, scarves, etc. Hardwood

TEXTILE TERMINOLOGY

WARP BEAM: The roller of a loom upon which the warp is wound.

HEDDLES: Vertically held parallel wires having an eye in the center through which the warp is drawn.

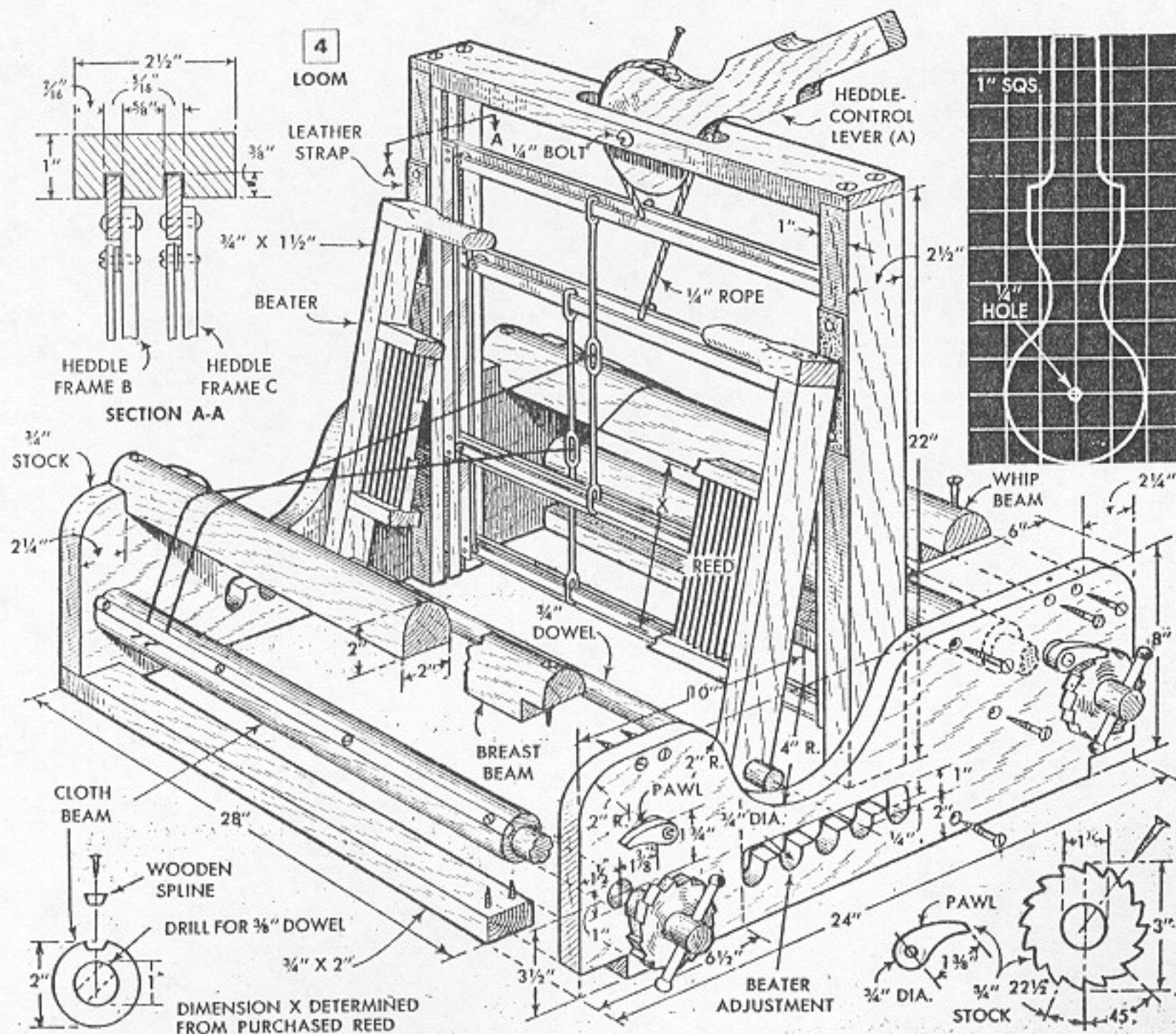
WARP: Threads that pass through heddles and reed.

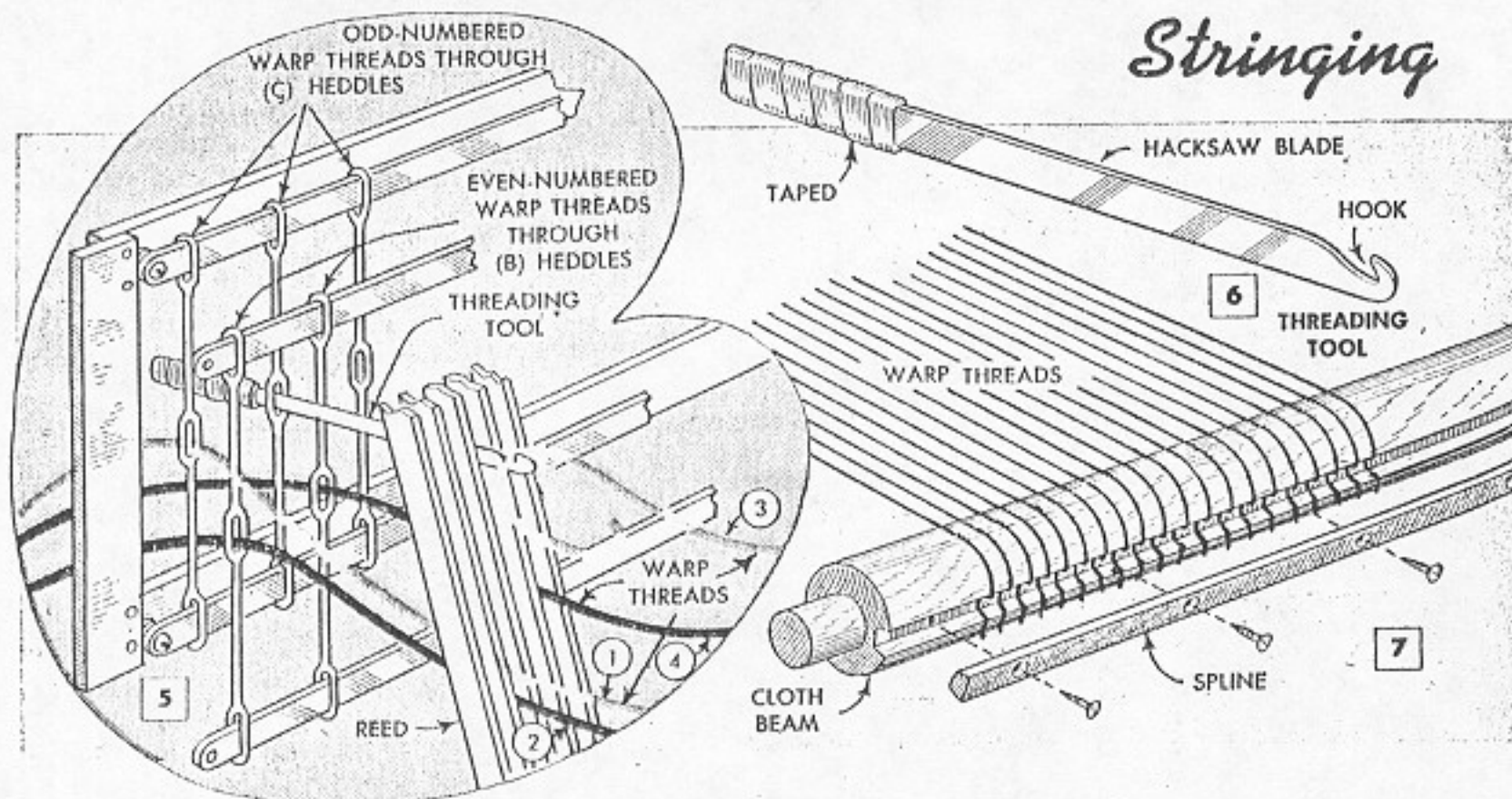
SHED: Space between warp when heddles are raised or lowered.

WEFT (WOOF): Threads or yarn interlacing the warp at right angles.

SHUTTLE: An instrument upon which weft is wound for passing through warp shed while weaving.

REED (BEATER): A device to comb or beat the weft between the strands of the warp.



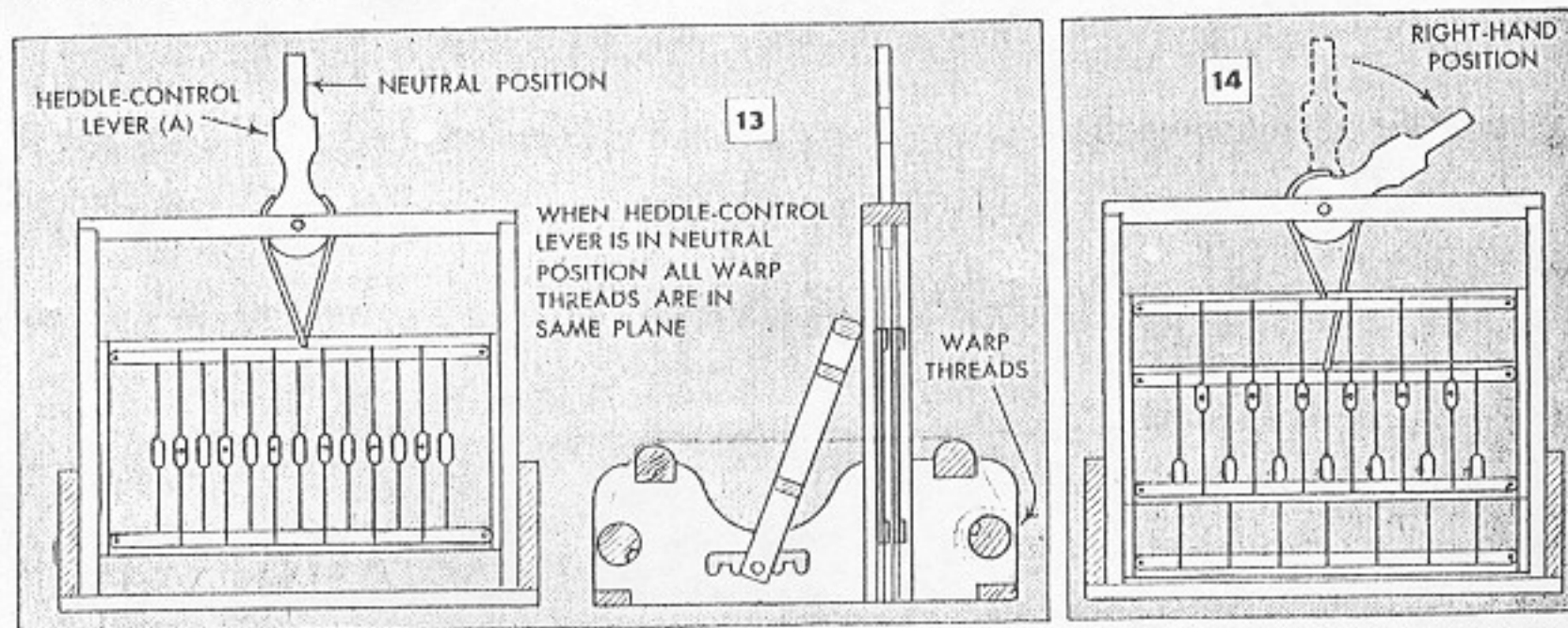


is used for all parts of the loom frame, the beater frame, rollers, and the breast and whip beams. Maple is good but birch does equally well and saws and planes somewhat easier. The heddles and heddle frames, Fig. 3, and the reed may be purchased from dealers in craftwork supplies. These parts are inexpensive and obtaining them ready-made saves a lot of time. For average weaving a 30-dent reed—30 spaces per inch—is satisfactory, as running the warp thread through each dent will give 30 warp threads per inch. Other combinations are possible.

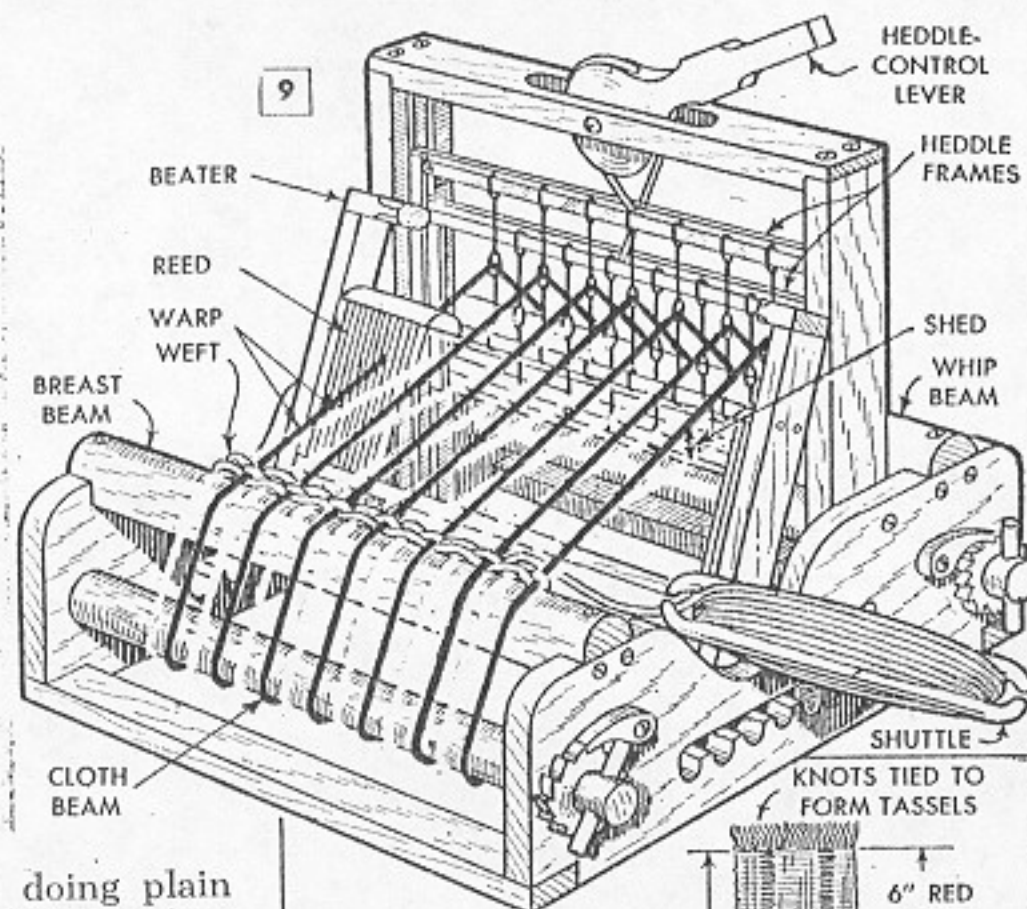
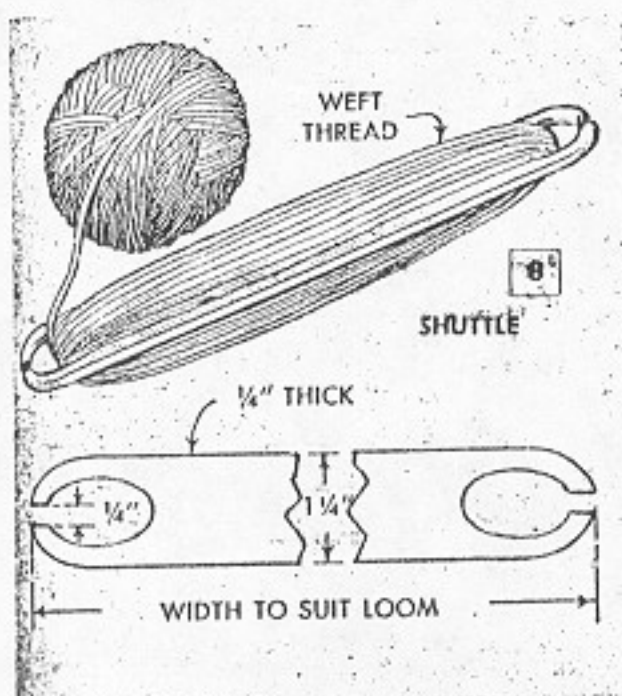
The heddle frames slide in grooves cut in the frame uprights, Fig. 4. The grooves should be about $\frac{1}{16}$ in. oversize so that the frames will slide easily. Two dimensions, one on the heddles in Fig. 3 and another on the reed in Fig. 4, must be determined from these parts. Have the parts at hand before assembling the loom. Hardwood ratchets and pawls on the rollers, Fig. 4,

are for the purpose of keeping tension on the warp threads and for rolling up the finished cloth on the cloth beam as the weaving progresses.

Fig. 2 shows methods of cutting 6 and 10-ft. warp yarn, or threads, to exact length. This done, you string the loom as in Figs. 5, 6 and 7. Notice in Fig. 5 how the odd-numbered warp threads are pulled through the heddles (C) with a threading tool made as in Fig. 6. The even-numbered threads go through the heddles (B). Both sets of threads pass over the whip beam and are wound on the warp beam at the rear of the loom. Study Fig. 9, which shows the warp threads in exaggerated size and in two colors for clarity. Also compare with the shed formed by shifting the heddle-control lever, Fig. 13, to the right-hand position as in Fig. 14. Fig. 7 shows how the ends of the warp threads are locked to the cloth beam with a spline which fits in a groove cut in the roller. Figs. 13 to 15 inclusive show the



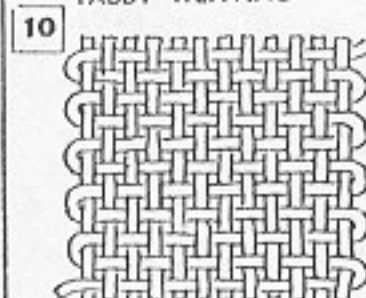
the Loom



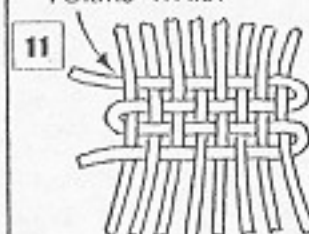
operation of the loom when doing plain weaving. Fig. 10 shows tabby weaving. Notes on the detail drawings, Figs. 13 to 15, explain the sequence of operations clearly. One thing to watch in weaving is the tendency to pull the weft too tightly. This forms what weavers call a waist, Fig. 11, and causes the woven strip to become narrower as the weaving progresses. Generally, tension on the weft must be watched more closely on coarsely woven cloth. The greater the number of warp threads per inch the less tendency there is for this fault to appear in weaving.

Fig. 12 shows a vari-colored pattern woven in a table scarf. Here variations are made in the warp threads and two shuttles are used, one carrying the red and one the blue filler or weft. Shuttles are made from a strip of hardwood with the ends shaped as in Fig. 8. Length of the shuttle should be approximately half the width of the cloth being woven, although some weavers prefer a shorter shuttle.

TABBY WEAVING



TENDENCY TO PULL WEFT TOO TIGHT FORMS WAIST



12 42" SCARF

6" RED FILLER

4" BLUE FILLER

22" RED OR COMPLEMENTARY COLOR

4" BLUE FILLER

6" RED FILLER

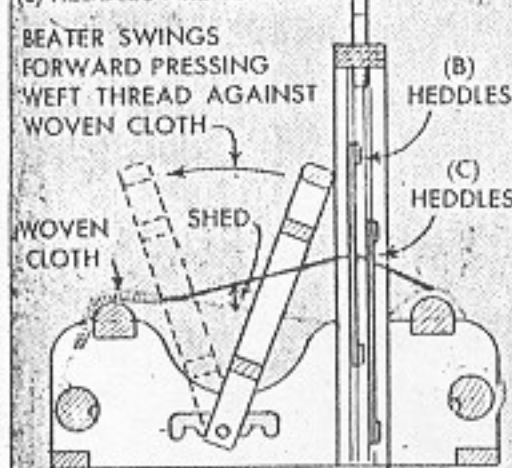
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1 3 5 7 9

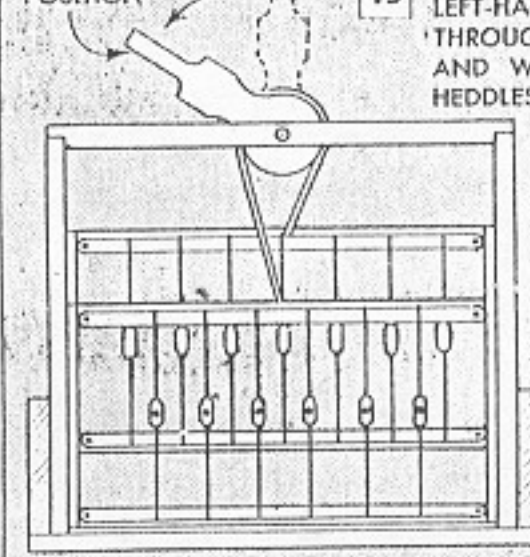
15 WARP THREADS PER INCH—ODD NUMBERS THROUGH (C) HEDDLES AND EVEN NUMBERS THROUGH (B) HEDDLES

CENTER OF SCARF

WHEN HEDDLE-CONTROL LEVER IS IN RIGHT-HAND POSITION, WARP THREADS THROUGH (B) HEDDLES ARE RAISED AND WARP THREADS THROUGH (C) HEDDLES ARE LOWERED



LEFT-HAND POSITION



15 WHEN HEDDLE-CONTROL LEVER IS IN LEFT-HAND POSITION, WARP THREADS THROUGH (B) HEDDLES ARE LOWERED AND WARP THREADS THROUGH (C) HEDDLES ARE RAISED

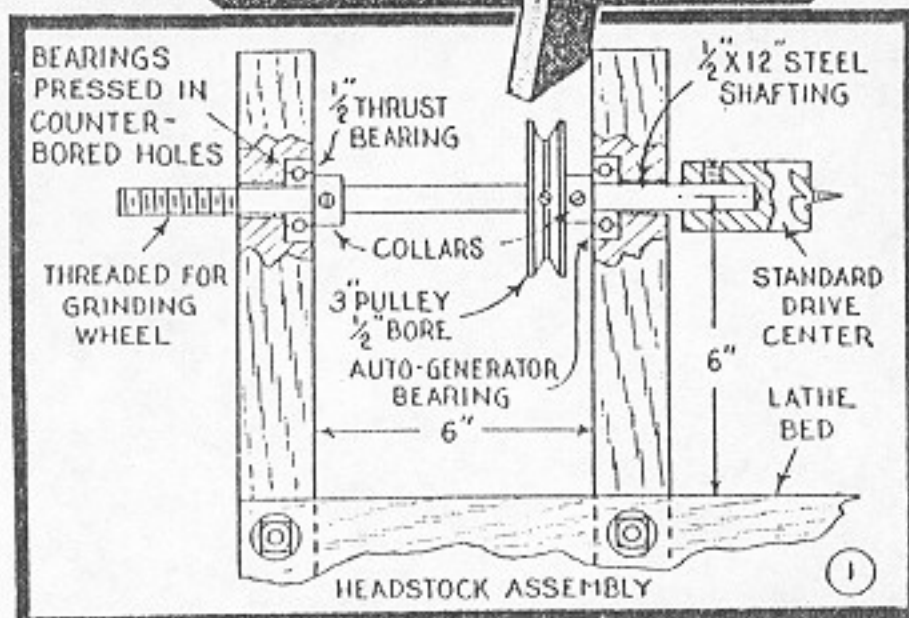
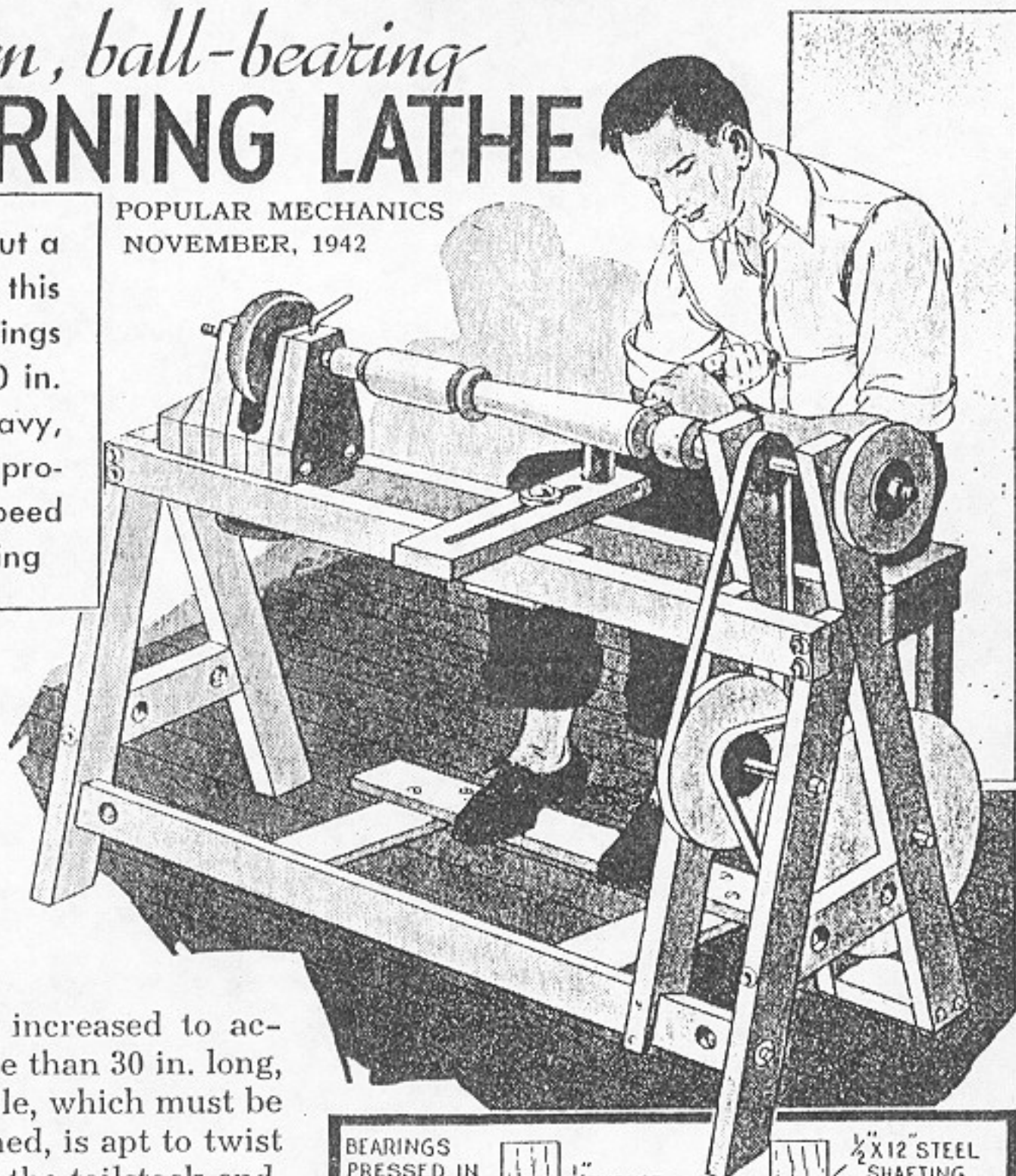
Treadle-driven, ball-bearing WOODTURNING LATHE

POPULAR MECHANICS
NOVEMBER, 1942

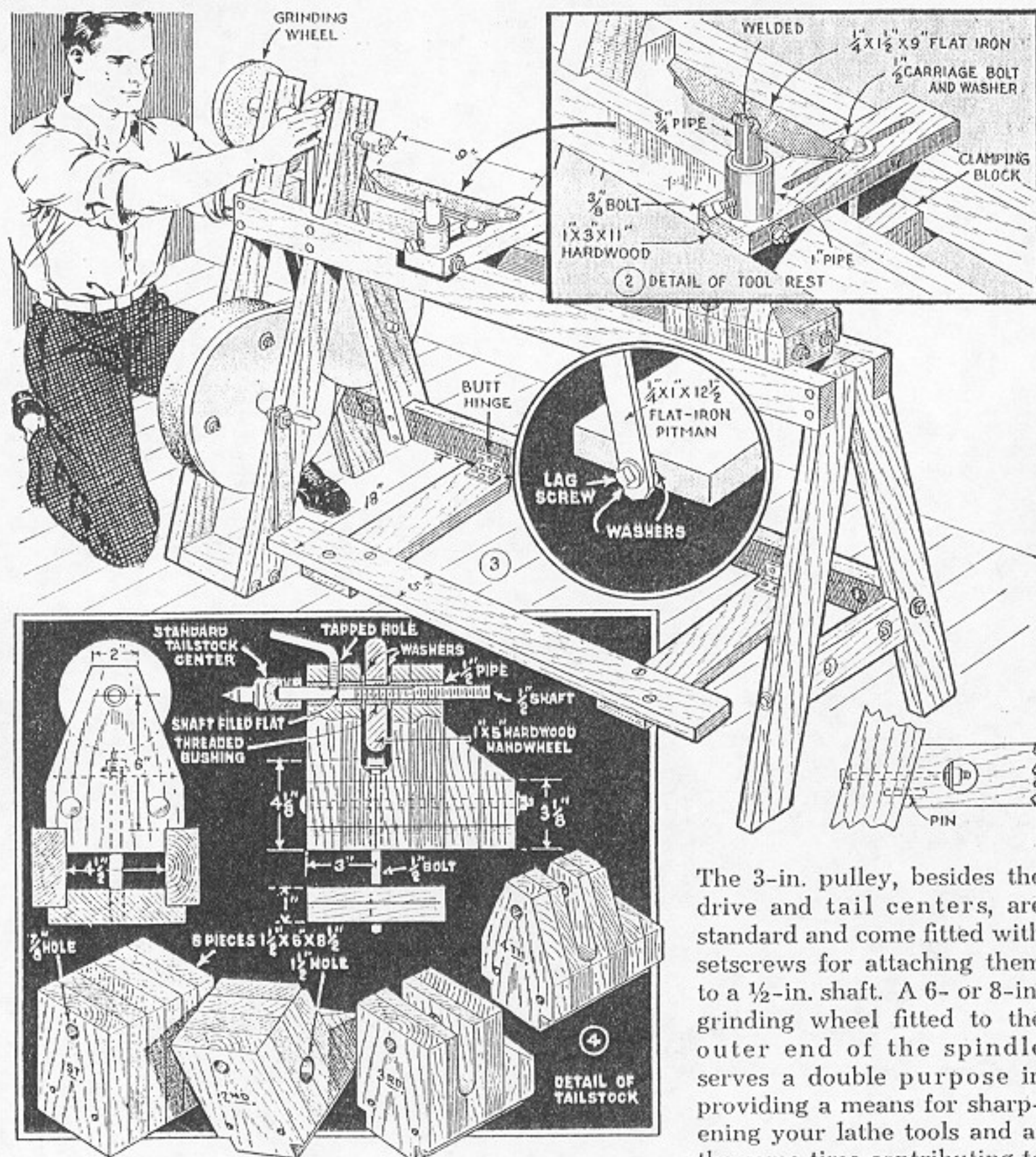
You need not go without a lathe as you can make this sturdy one of wood. Swings 12 in. over bed and 30 in. between centers. A heavy, balanced countershaft provides uniform spindle speed with moderate pedaling

By W. C. Leckey

WITH the exception of turned wooden pulleys and the form to cast a flywheel, you can build this efficient treadle lathe with a few hand tools. Distance between centers can be increased to accommodate turnings more than 30 in. long, but in doing so, the treadle, which must be correspondingly lengthened, is apt to twist when pedaling is done at the tailstock end. Spindle height is such to enable one to pedal the lathe from either a standing or sitting position. Approximately 100 downward strokes of the treadle per minute will give a spindle speed recommended for turning. Common 2-by-4-in. fir stock is satisfactory for the stand. Side and front views in Fig. 8 give the correct length to cut each member. Note how the headstock is incorporated in the twin front legs. Except for fastening the bed pieces, the type of assembly shown to the right of Fig. 3 is used throughout, which permits tightening joints that may become loose. The small pin indicated is provided to keep the members in line when drawing up the bolts. Endless V-belting or round leather



belting, joined, will do to rig the countershaft. As no tension adjustment is provided, it will be necessary, if an endless belt is used to drive the headstock spindle, to vary the position of the rear countershaft pulley to be able to stretch the belt snugly



The 3-in. pulley, besides the drive and tail centers, are standard and come fitted with setscrews for attaching them to a 1/2-in. shaft. A 6- or 8-in. grinding wheel fitted to the outer end of the spindle serves a double purpose in providing a means for sharpening your lathe tools and at the same time contributing to

over it. Belt dressing can be used if slippage develops.

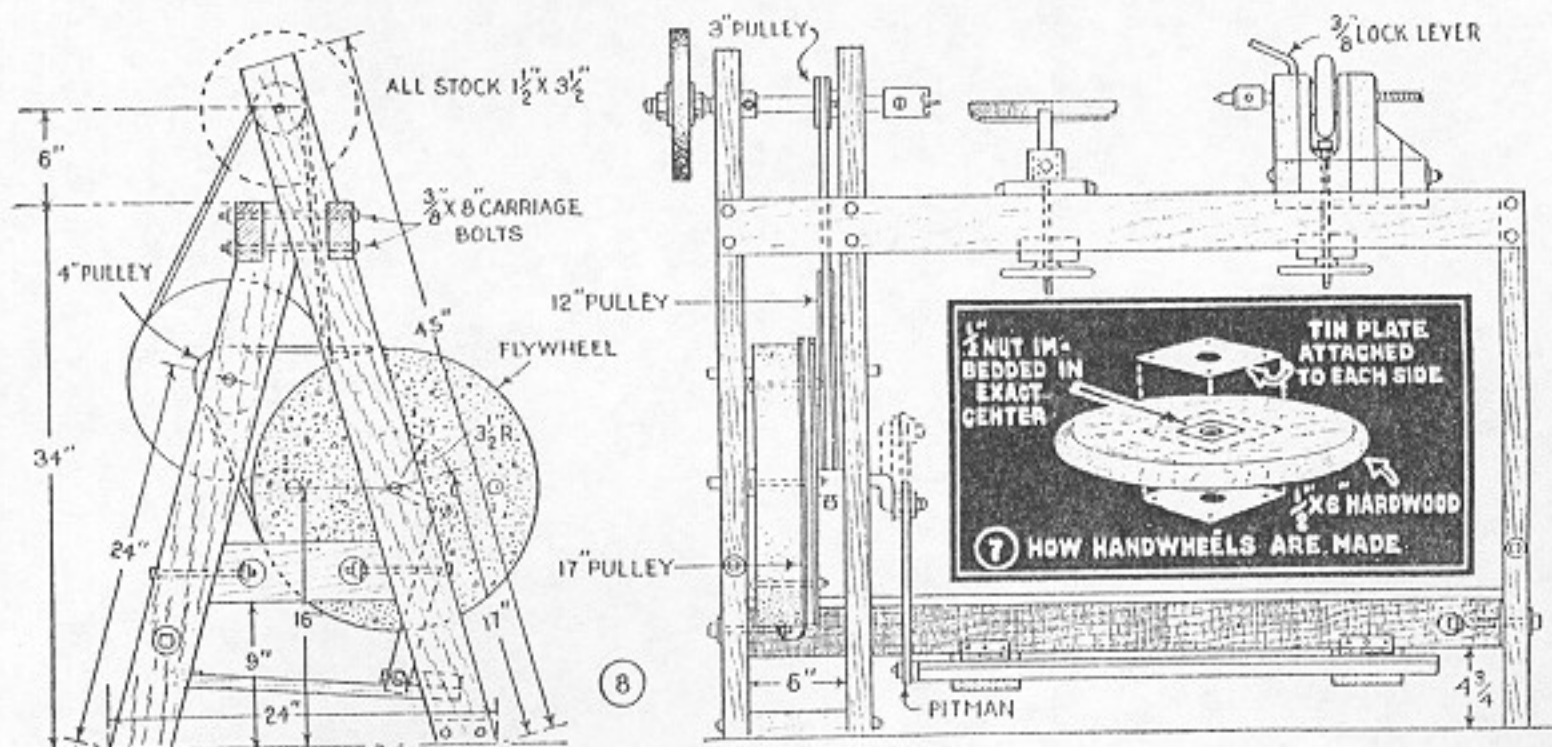
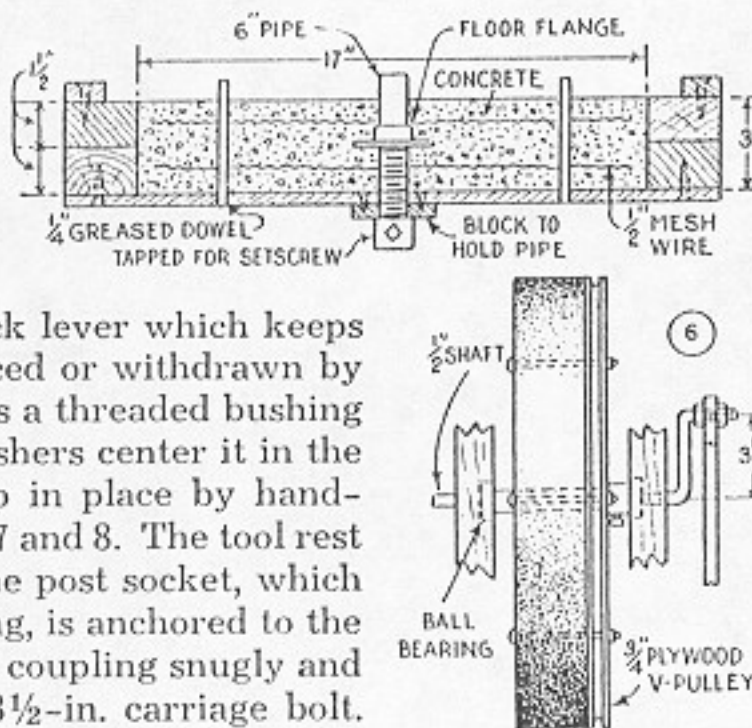
Ball bearings in both the headstock and countershaft make the lathe exceptionally smooth running and are preferred to bronze bearings, although Ford model-T spindle body bushings can be used if you are unable to secure ball bearings. Fig. 1 details the headstock. The holes for the bearings must be centered an equal distance above the bed and counterbored on facing sides to provide a press fit for the bearings. An auto-generator bearing will do for the inner bearing, but the outer one should be of the type to take end thrust when pressure is applied by the tailstock.

the momentum. Collars are used against each bearing to take up end play.

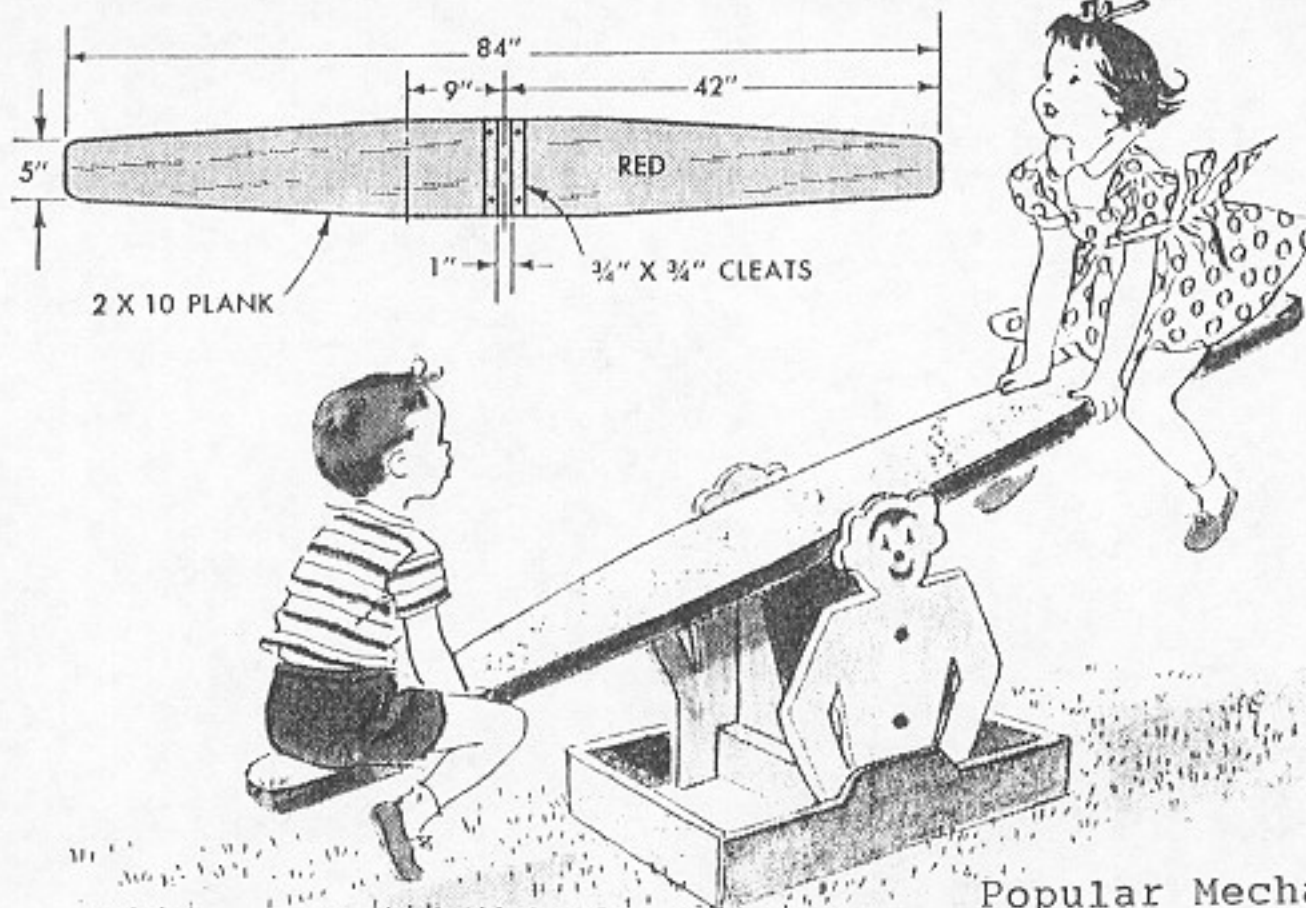
The flywheel detailed in Figs. 5 and 6 provides the necessary momentum to keep the spindle turning at a uniform speed. Extra care must be used in centering the hub to have the flywheel run fairly true. About the easiest way to do this is to first mark a 17-in. circle on the plywood bottom of the form by which it can be centered when fastening it in place with screws. Then a hole is drilled in the exact center to take the 1/2-in. pipe hub snugly. A cleat across the top of the form holds the upper end of the pipe in position, while at the bottom a small block and a coupling

are used. The pipe should extend about $\frac{1}{2}$ in. above the top of the form. As the drive pulley is fastened directly to the flywheel, greased dowels are placed in the form to provide bolt holes for this in the casting. Use a fairly rich aggregate consisting of cement, 1 part, sharp sand, 3 parts, and place pieces of wire mesh in the form as the pouring progresses to reinforce the work. Allow the concrete to set several days until fully cured. The flywheel is fastened to the pitman crank by a setscrew tapped in the coupling. Note in Fig. 8 that the point of fastening the pitman to the treadle should be directly in line with the flywheel shaft. Bearings for the countershaft assembly are fitted the same as those in the headstock. Plywood is best for the countershaft pulleys, the two rear ones being turned and grooved separately, screwed together and pinned to their shaft. Here collars are used as before to take up end play.

Fig. 4 details the tailstock and shows the progressive steps to follow in shaping the glued-up block. The spindle hole, which is bored while the block is still square, is bushed on each side of the handwheel opening with a $\frac{1}{2}$ -in. pipe nipple to receive a $\frac{1}{2}$ -in. threaded shaft. Note that one side of the shaft is filed flat for the end of the lock lever which keeps the spindle from turning when being advanced or withdrawn by the handwheel. The latter is of wood and has a threaded bushing imbedded in its center to fit the spindle. Washers center it in the opening. Both tailstock and tool rest clamp in place by handwheels fitted below the bed as shown in Figs. 7 and 8. The tool rest and holder are made according to Fig. 2. The post socket, which consists of a 1-in. pipe nipple inside a coupling, is anchored to the base by boring a hole in the latter to take the coupling snugly and then drilling crosswise through both for a $3\frac{1}{2}$ -in. carriage bolt.



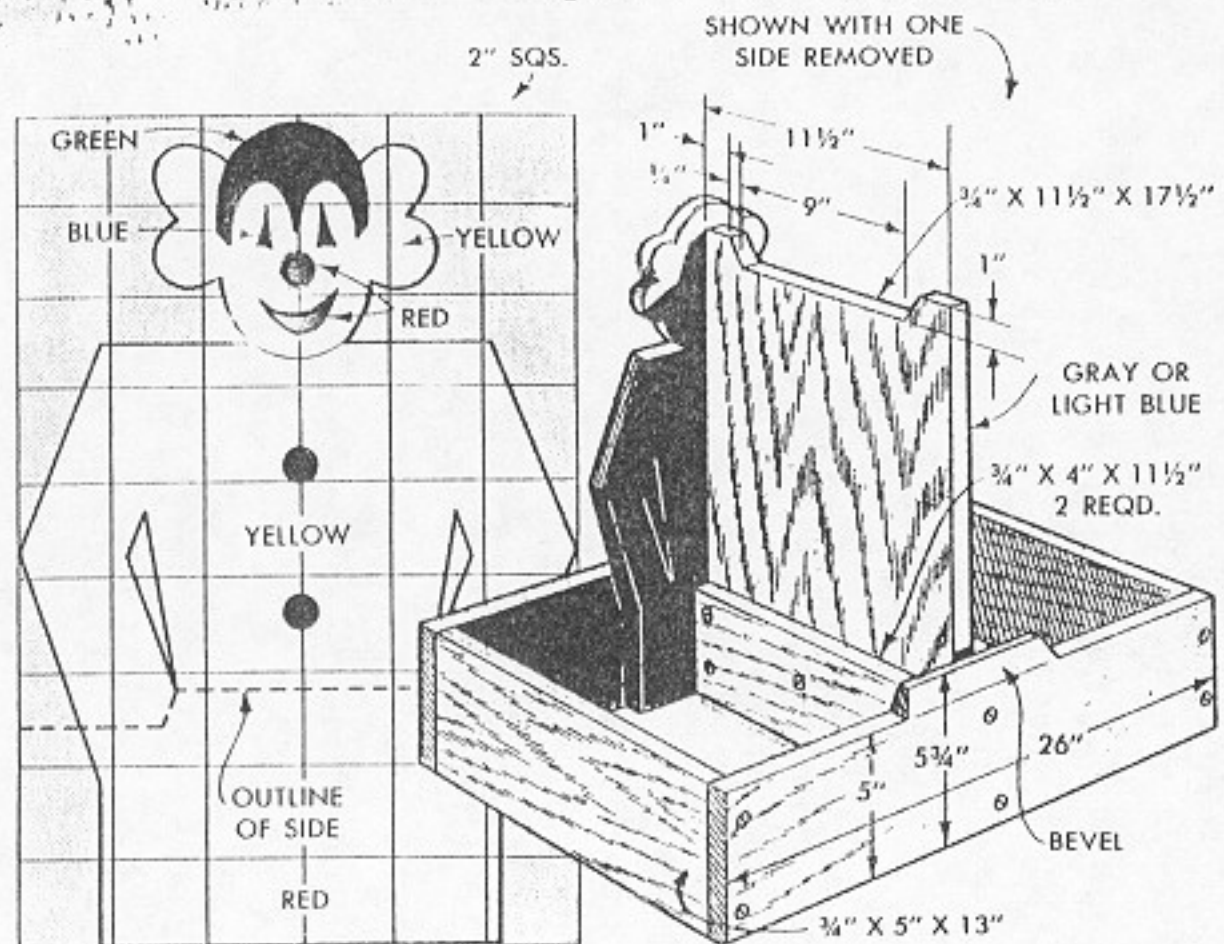
SEESAW TOY IS SUPPORTED BY CLOWN CUTOUTS

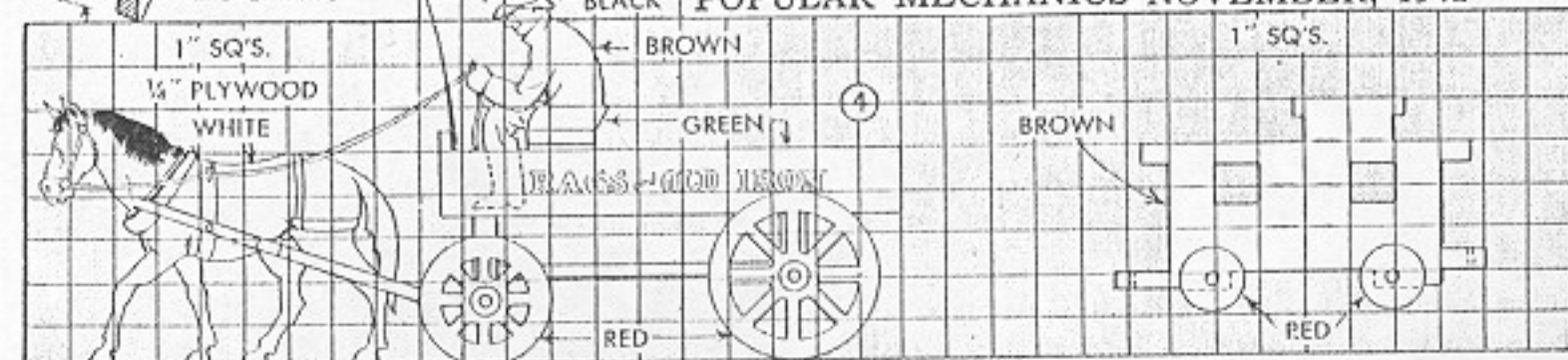
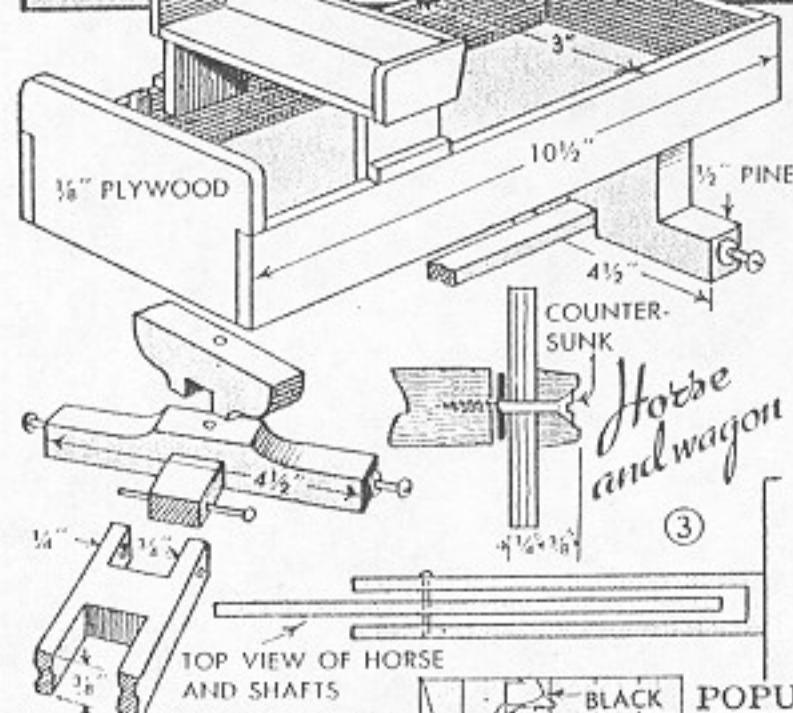
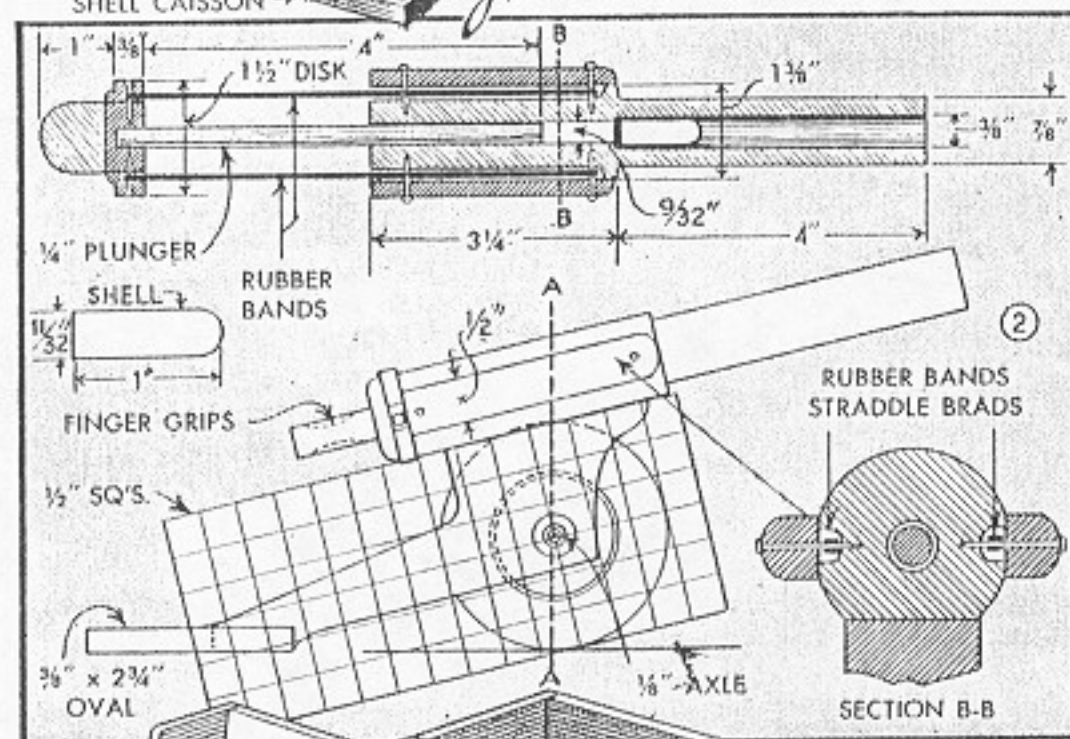
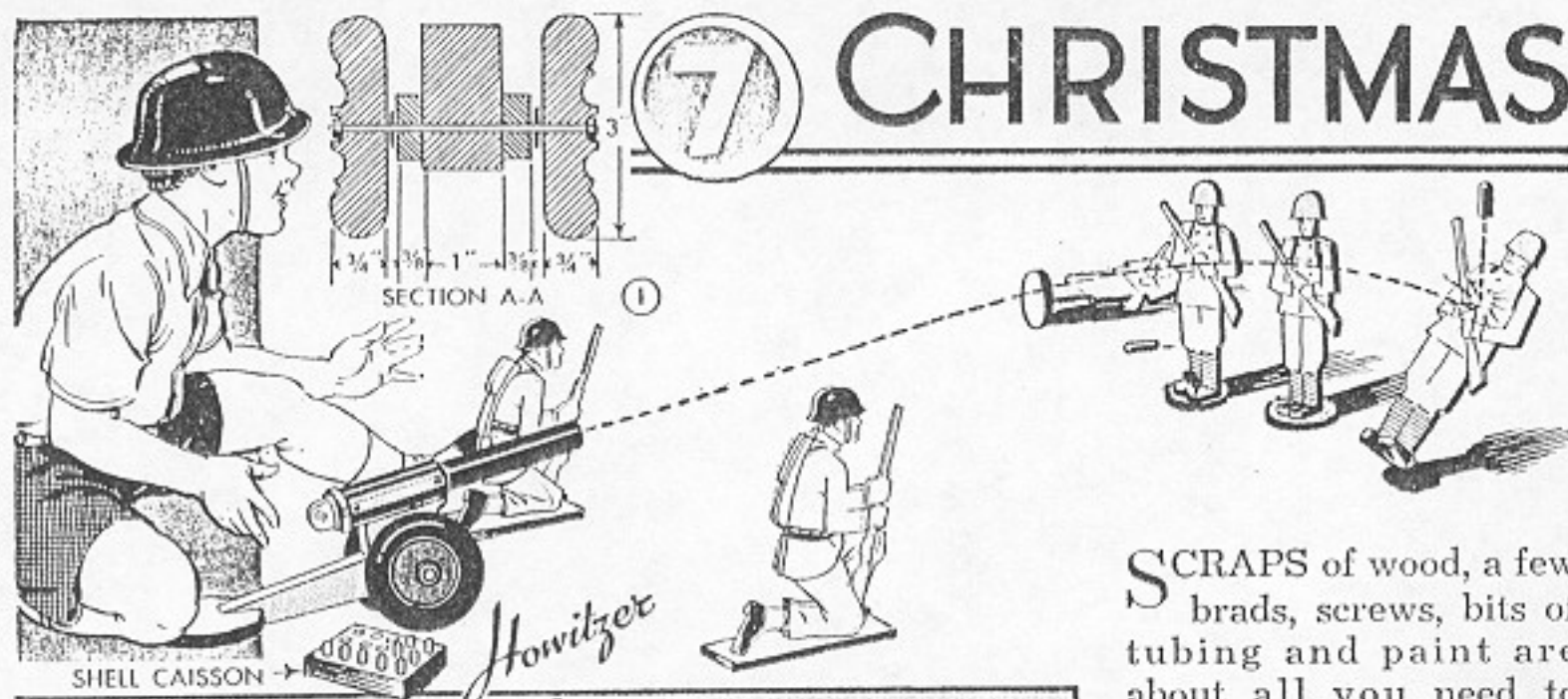


Popular Mechanics May 1950

By
Marvin
Hartley

Youngsters, from toddlers on up, will have a circus with this novel seesaw. Two clown cutouts joined back to back form the pivot for the plank. The complete toy is made from stock lumber, the plank being a 2 x 10, narrowed at each end and sanded smooth to prevent splinters. The pattern for the clowns is enlarged full size and cut from 3/4-in. outdoor plywood. The boxlike base is filled with sand to prevent tipping. Enamel the toy in gay colors



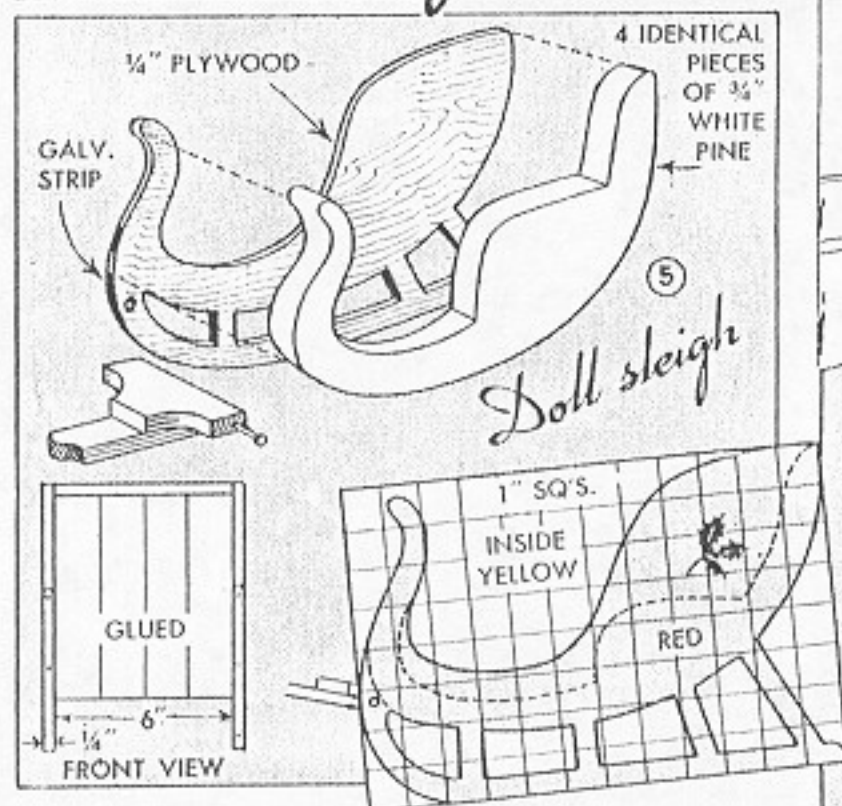


SCRAPS of wood, a few brads, screws, bits of tubing and paint are about all you need to make these interesting wooden toys. Any boy will feel like a real soldier when he knocks out the enemy with the howitzer shown in Figs. 1 and 2. The gun shoots a wooden projectile which has a rounded nose, so that it does little damage even in a direct hit. Rubber bands are attached to a plunger or firing pin and work in grooves along the side of the barrel where they straddle brads at the forward end that hold the imitation recoil cylinders in place. If drills available are not long enough for boring out the barrel, it can be made in two pieces, slotting each half through the center with a gouge, then smoothing and truing the bore with sandpaper wrapped on a dowel. When these operations are finished, the two pieces are glued together so that the two slots form a round hole through which the shell passes.

With the collection of scrap materials now so important, the junk collector's horse and wagon in Figs. 3 and 4 will be appropriate in teaching the children to gather these materials. It can be made

POPULAR MECHANICS NOVEMBER, 1942

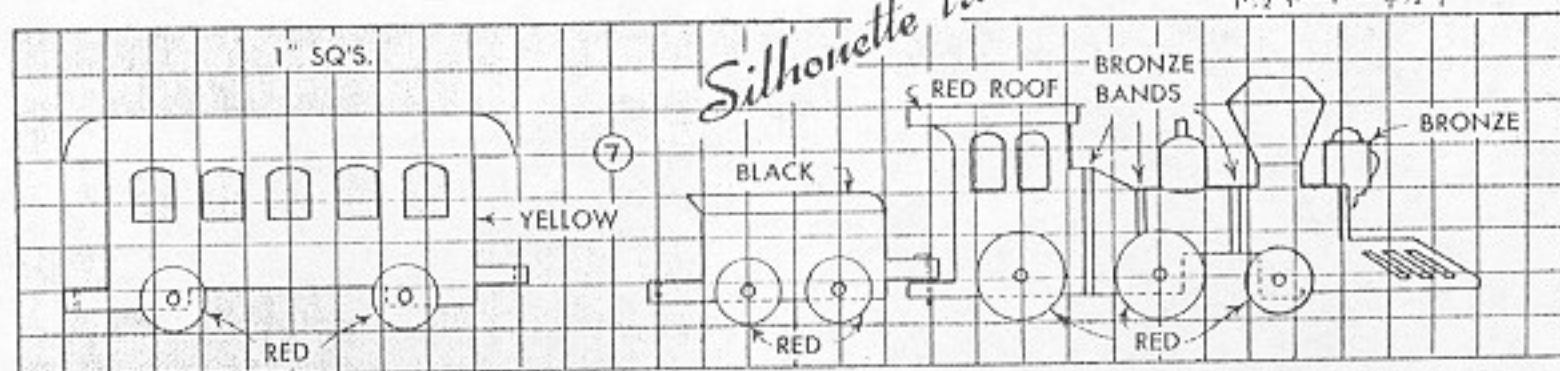
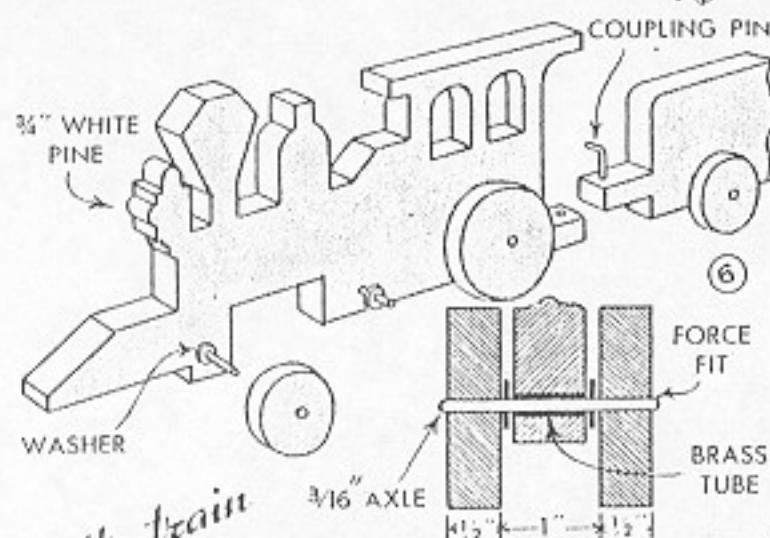
TOYS of wood

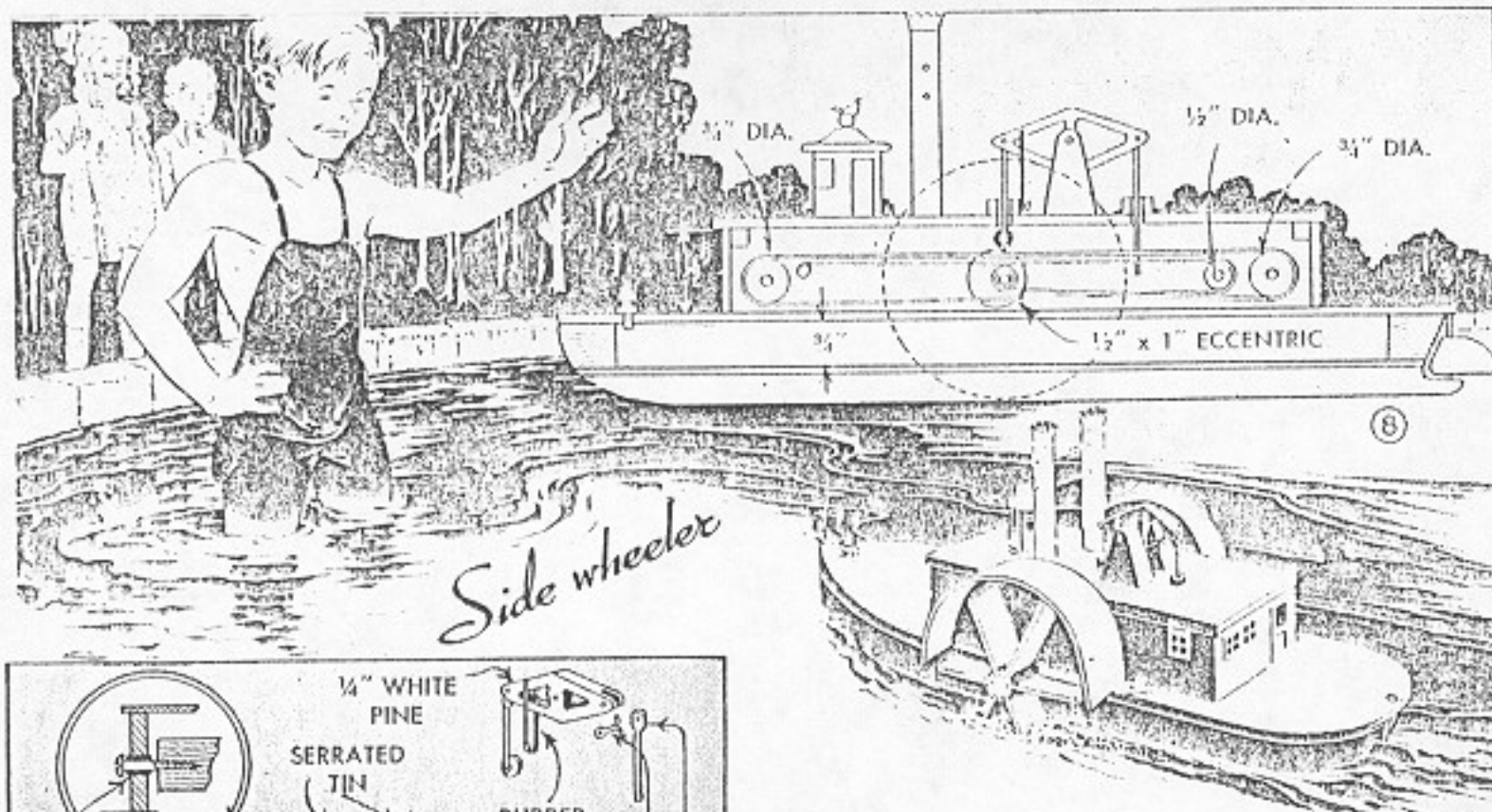


quite appealing to the eye as the toy lends itself to a lively color scheme as indicated.

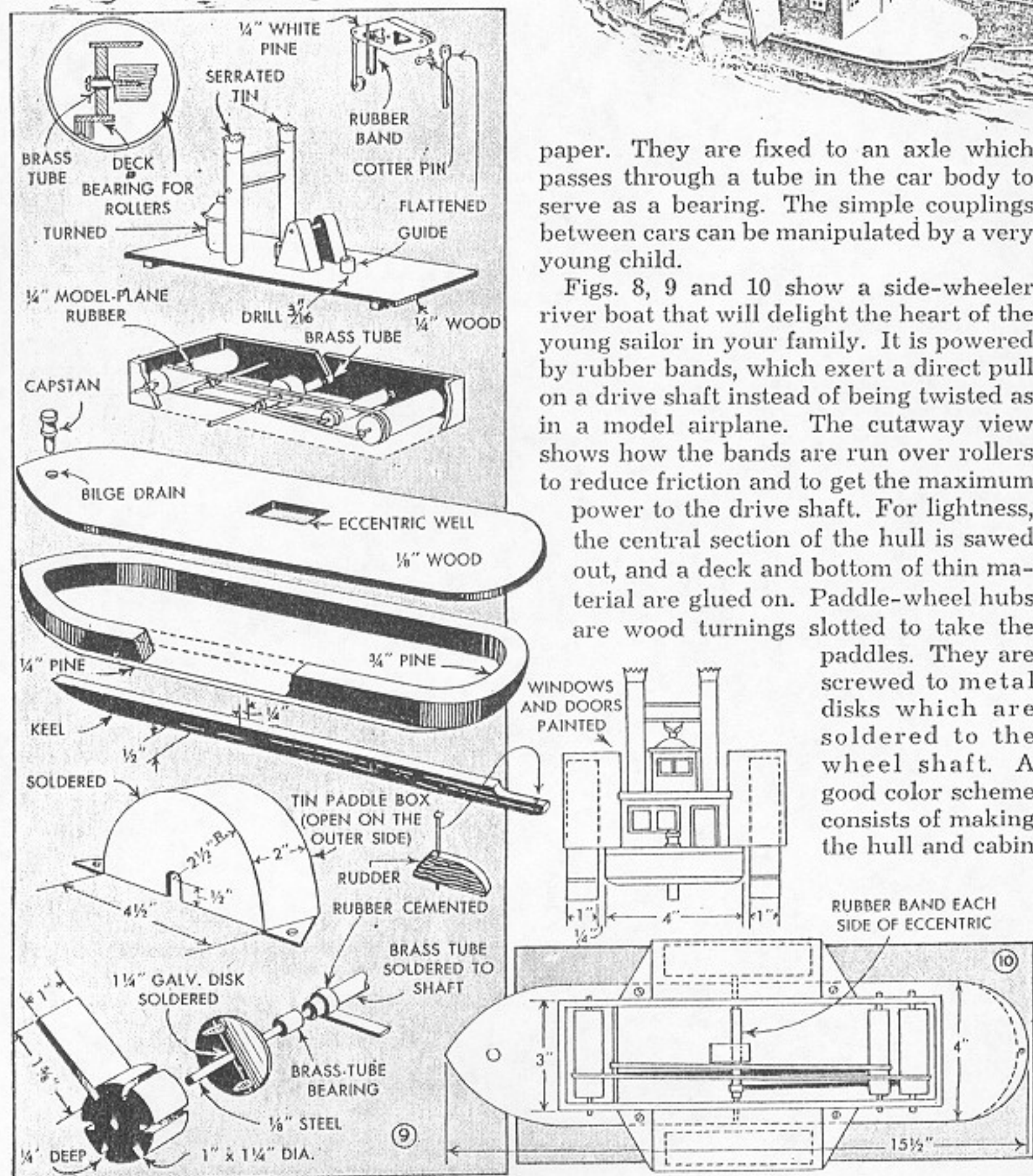
A doll sleigh like the one in Fig. 5 will thrill the young feminine members of your family. A coping or jigsaw will enable you to cut the six pieces that form the sleigh. Sides are complete with runners, and the seat, floor and dash are built up of four pieces, which are glued together. A tongue for pulling the sleigh is pivoted between the runners at the front end. If available, strips of thin metal can be used as shoes for the runners.

Designed after models of Civil-war time, the train in Figs. 6 and 7 will stand a lot of rough handling. Making it is a job for the jigsaw and by stacking your stock, you can cut out material for two or three trains at one time. Be sure to cut the wood so that the grain runs lengthwise of the train as this will help prevent parts from splitting off easily. By duplicating passenger cars, a long express train can be made. The wheels are best turned in a lathe, although you can make them with a saw and sand-





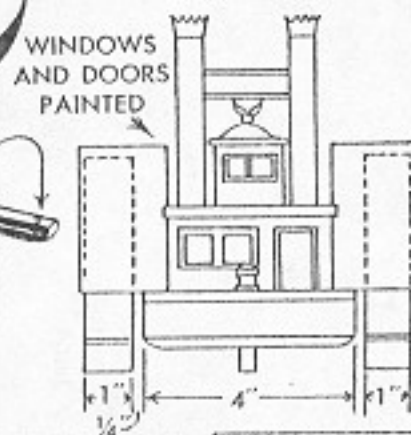
Side wheeler



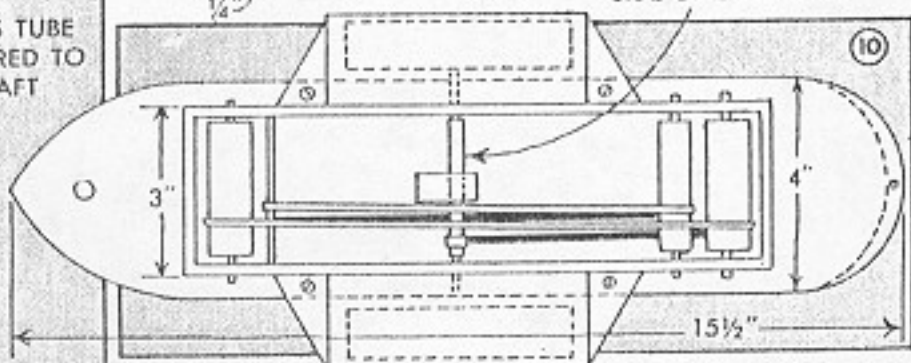
paper. They are fixed to an axle which passes through a tube in the car body to serve as a bearing. The simple couplings between cars can be manipulated by a very young child.

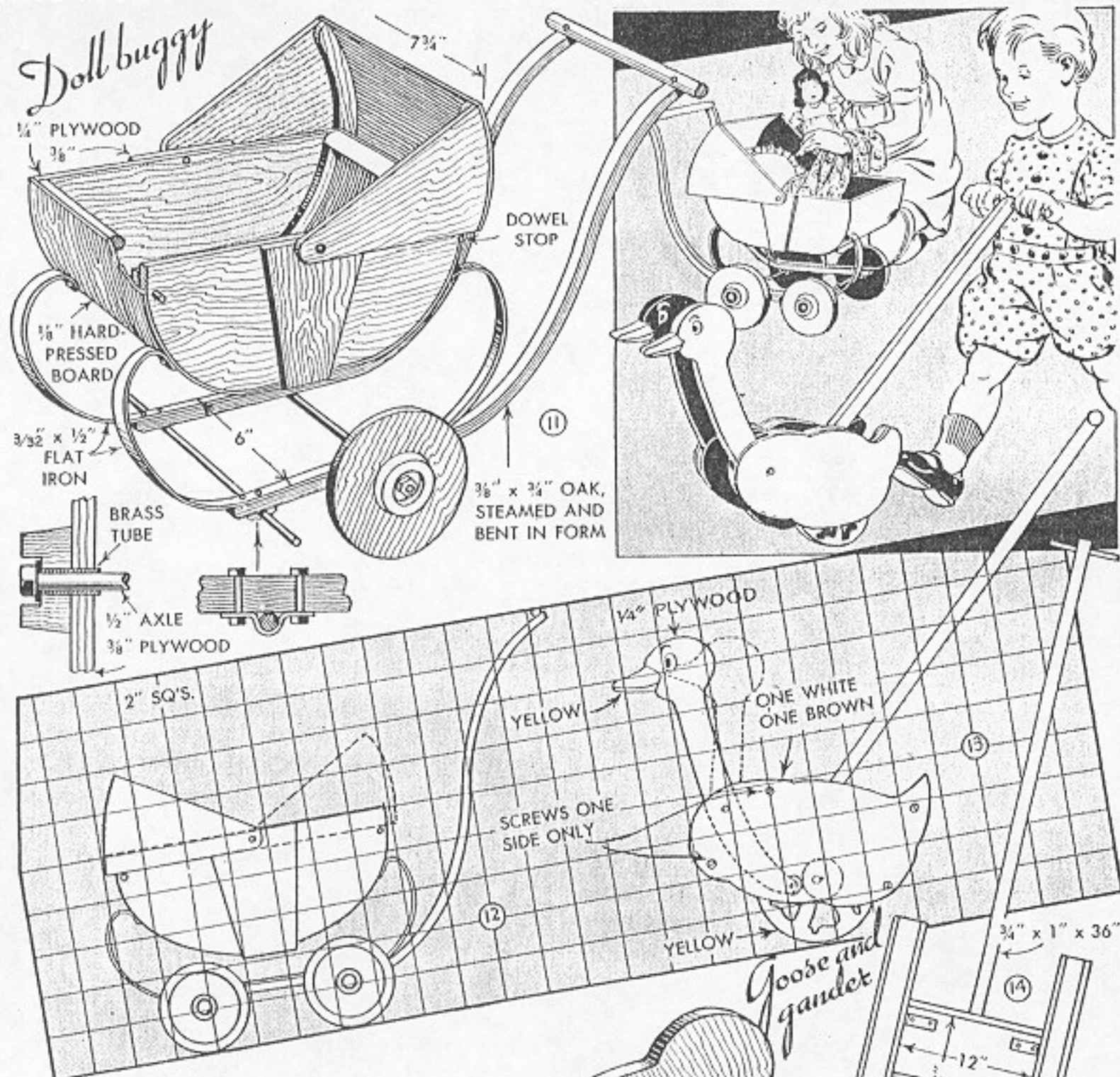
Figs. 8, 9 and 10 show a side-wheeler river boat that will delight the heart of the young sailor in your family. It is powered by rubber bands, which exert a direct pull on a drive shaft instead of being twisted as in a model airplane. The cutaway view shows how the bands are run over rollers to reduce friction and to get the maximum power to the drive shaft. For lightness, the central section of the hull is sawed out, and a deck and bottom of thin material are glued on. Paddle-wheel hubs are wood turnings slotted to take the paddles. They are

screwed to metal disks which are soldered to the wheel shaft. A good color scheme consists of making the hull and cabin



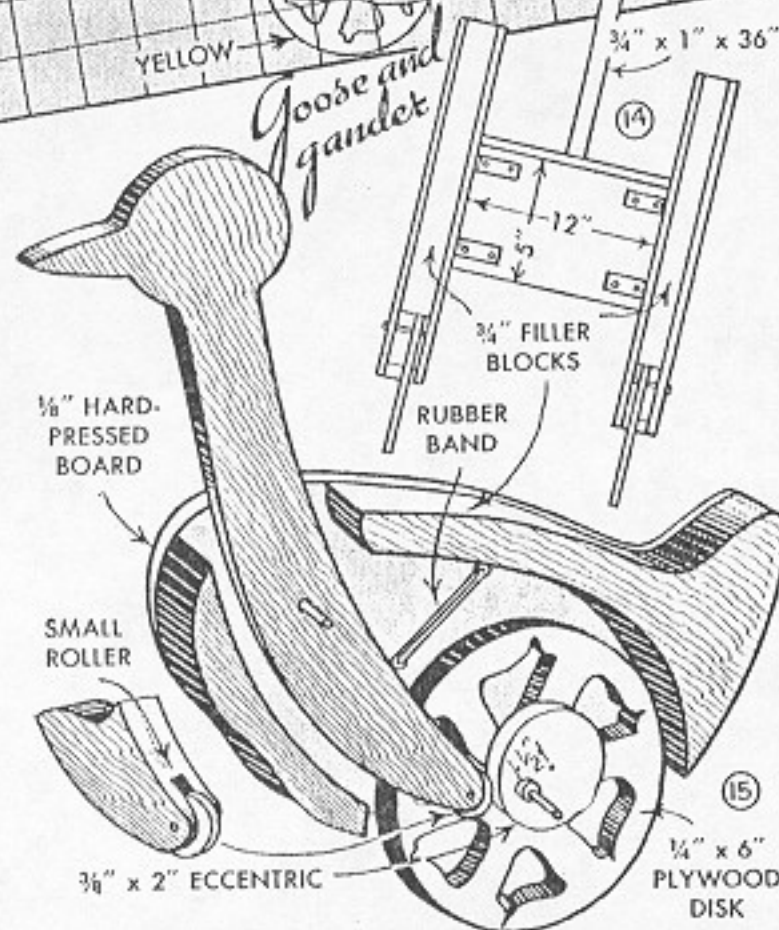
RUBBER BAND EACH SIDE OF ECCENTRIC





white with red below the water line and on the rudder, paddle boxes and walking beam. If the deck is varnished in natural wood with the top of the cabin painted gray, and the smokestacks black with bronze on the fluted tops, you will have a pleasing combination.

Designed along the lines of an English perambulator, the doll carriage in Figs. 11 and 12 can be made almost any size desired by enlarging the dimensions given. Wooden wheels are shown, but some taken from a discarded scooter or other toy can be used. The springs are shaped from light flat iron and the handles are steamed and bent to shape over a wooden form. The entire job can be made of plywood or hard-pressed board if a wood framework is made heavy enough to receive small screws. Note that the hubs are counterbored so that the projecting axles or nuts cannot damage furniture or woodwork in the home.



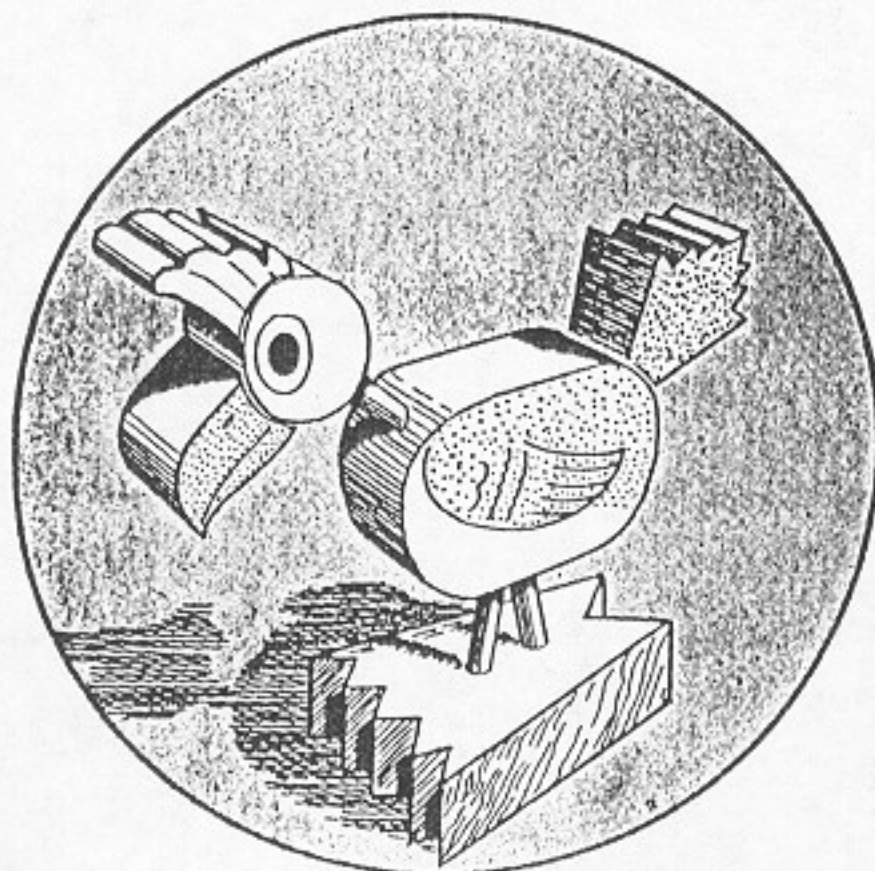
When pushed along a sidewalk or over a floor, the pair of geese in Figs. 13, 14 and 15 move their heads back and forth in a realistic manner, while bright yellow legs keep stepping along briskly. The latter are circular to avoid a bumping motion.

Magic Bird Toy for the Kiddies

Every time a dozen or more pieces are put together, a

SCIENCE AND MECHANICS Oct.-Nov. 1941

startling new bird appears.

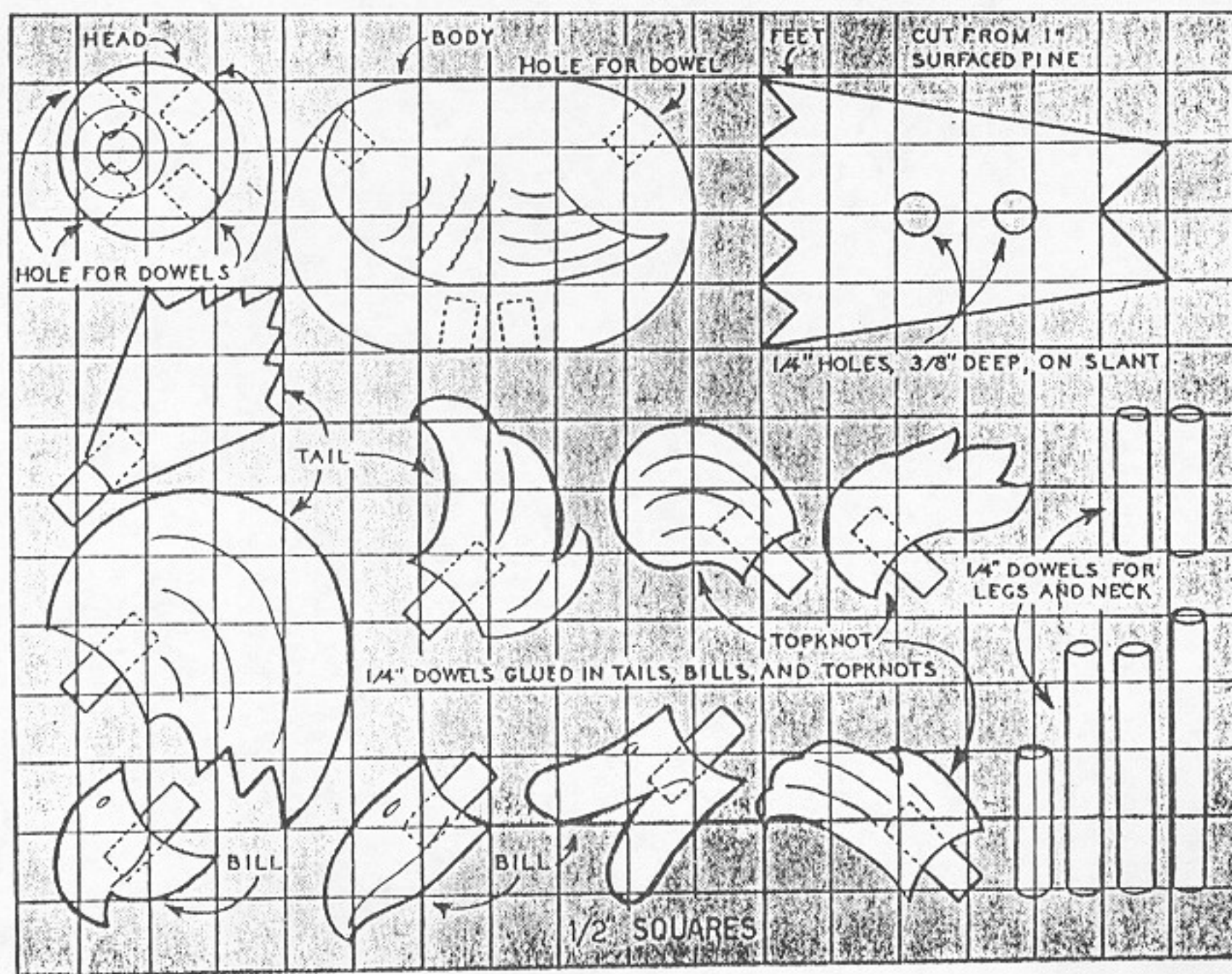


CHILDREN can find never-ending amusement in putting colorful blocks and dowels together to form an endless variety of wooden birds. By changing bills, topknots, tails, legs and necks, many startling effects can be obtained.

Draw the various pieces, as shown in the illustrations, on paper; then trace these drawings to 1-in. surfaced pine. Cut them out with a jig saw. Be sure the bills and topknots curve to fit the head, and the tails fit the body.

Now drill $\frac{1}{4}$ -in. holes $\frac{3}{8}$ -in. deep in these pieces as indicated, and glue $\frac{1}{4}$ -in. dowels $\frac{3}{4}$ -in. long into them. Drill $\frac{1}{4}$ -in. holes $\frac{3}{8}$ -in. deep in the body, head and feet to accommodate these dowels.

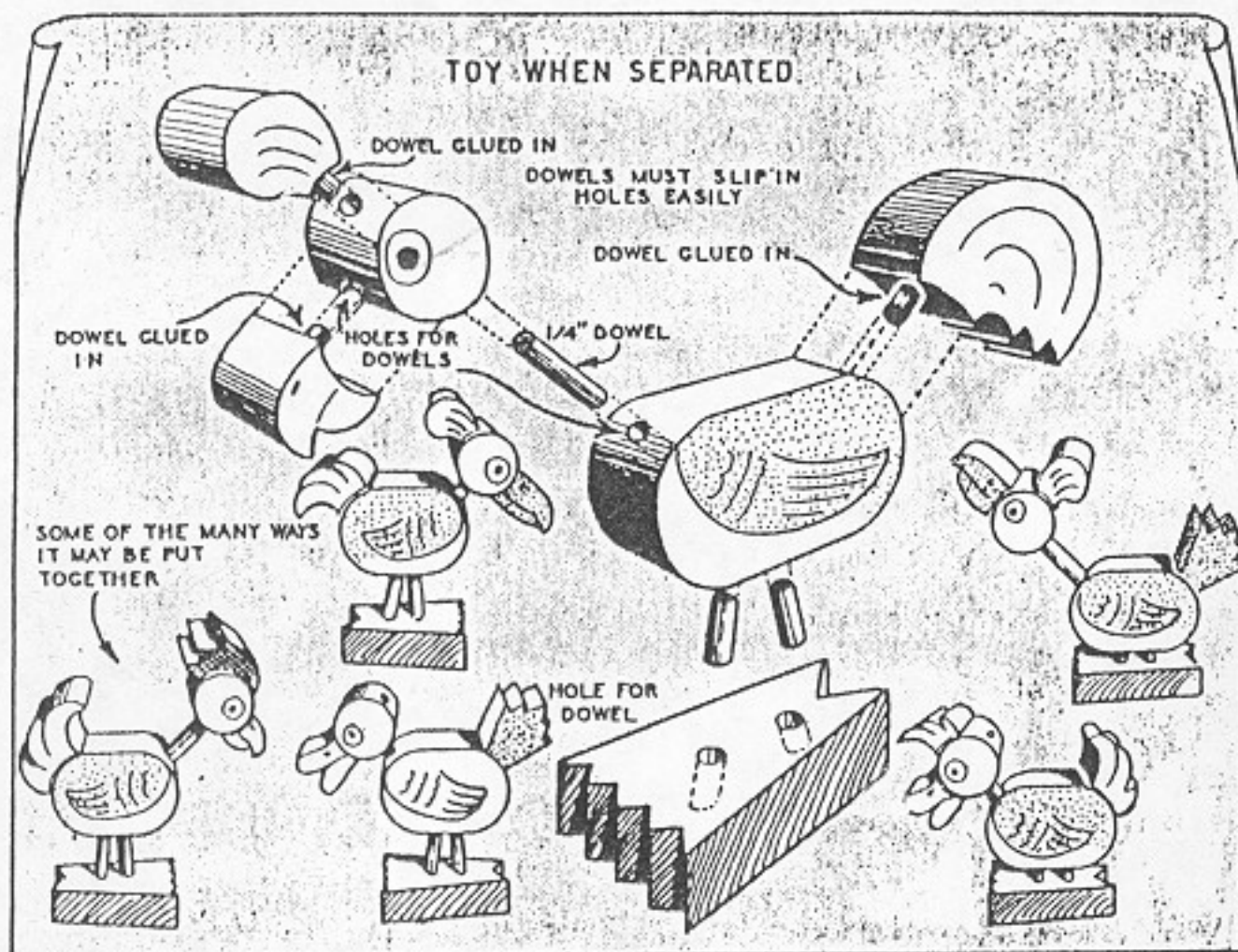
Cut three $\frac{1}{4}$ -in. dowels 1-in. long, two $1\frac{3}{4}$ -in. long and one 2-in. long for the legs and necks. Be sure to make the holes in the body, head and feet large enough so the dowels will slip in and out easily. Paint these pieces with bright colors, and you will have a toy that



will be an everlasting favorite.

Only a few of the possible combinations of parts are shown in the illustrations. Many more are possible. The kiddies can make a game of it by seeing who can "build" the strangest looking "bird" and who can make the greatest number of "birds" without repeating one.

This same idea can be applied to other creatures than birds, too. Queer-looking animals of many kinds could be worked out in similar manner.



Frolic Color Wheel

G. EVERETT VAN HORN Popular Homecraft May, 1944

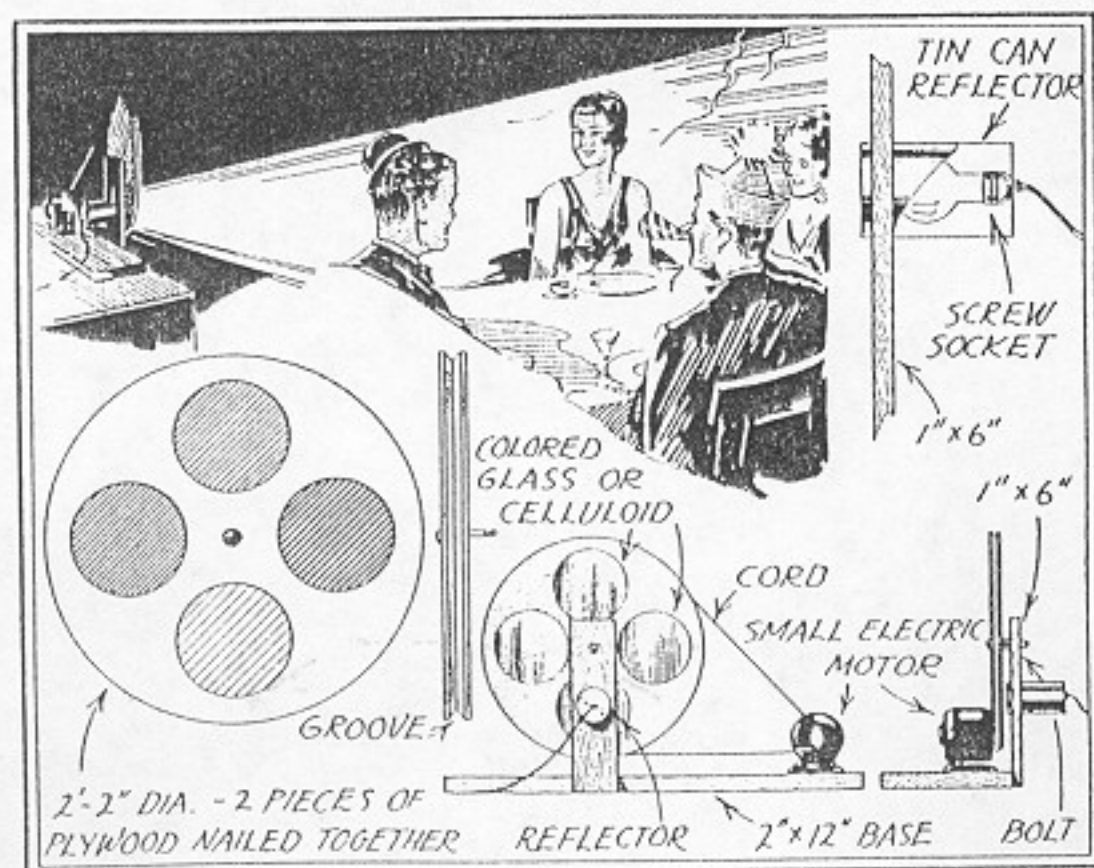
USE this shop-made revolving color wheel for dinner parties in your home, for illuminating the Christmas tree and room, or for other gay occasions. The wheel will cast a fast-changing series of color lights about the room. Make the wheel from two circular pieces of plywood, nailed together as shown. Cut a groove in the edge for a stout cord drive belt, and saw out four equidistant holes in the wheel, each about 7" in diameter.

Across the back of the wheel fasten the edges of four colored panes of glass with tacks, or use colored celluloid. Have yellow, red, green, and some other bright color. Bore a hole in the exact center to take a tight fitting bolt, and fasten the wheel to the upper end of a one-by-six upright nailed solidly to the edge of the plank base as shown. Below the bolt cut a round opening for a tin can reflector, situated so that the center of the glass openings in the color wheel pass across the end of the reflector.

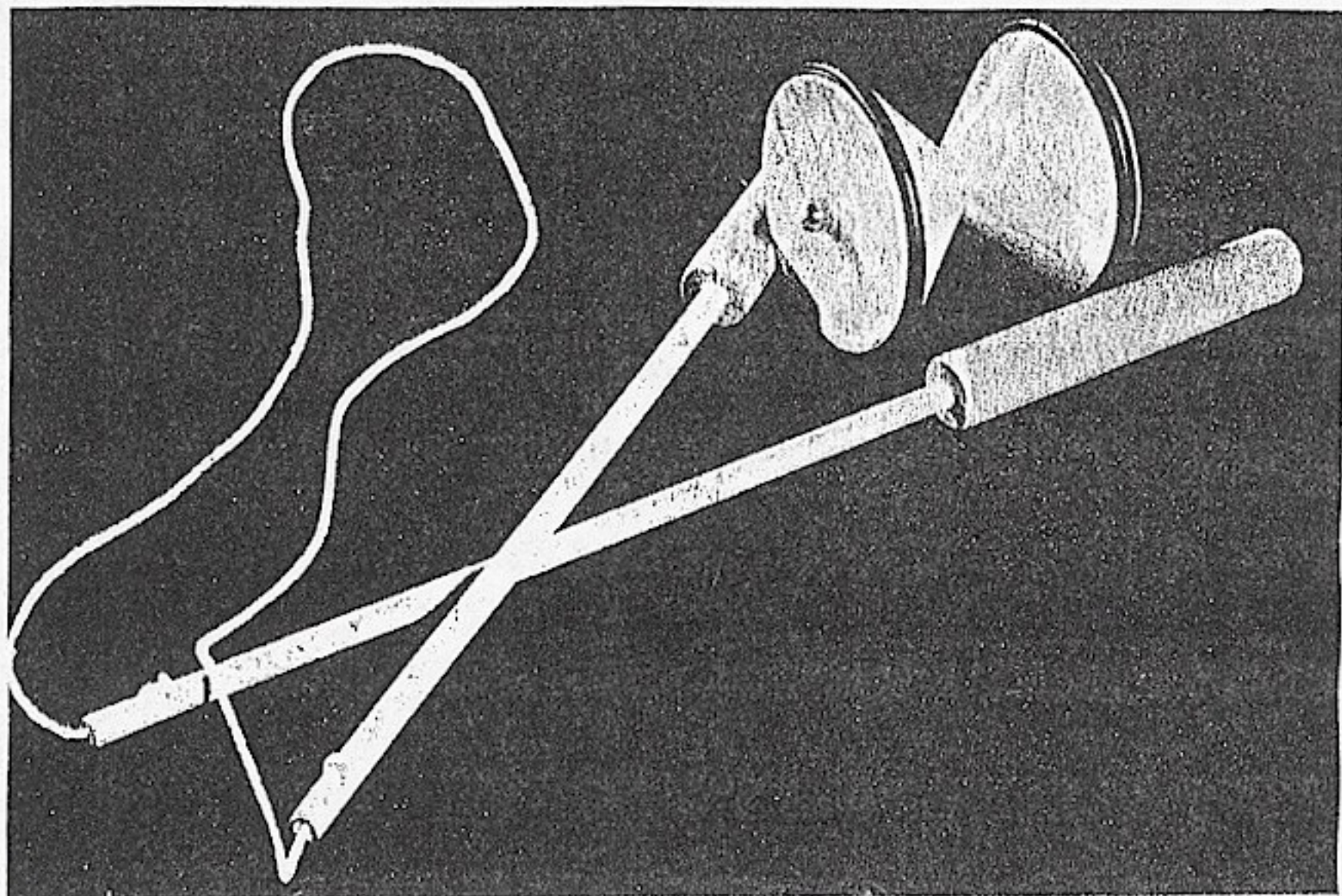
In the bottom of the can punch a hole to take a screw socket and a large bulb. The bolt axle of the wheel should be greased and two or three metal washers placed between

the wheel and upright. Use two nuts at the back of the upright, one for a lock nut, to allow the wheel to turn smoothly. Connect it with a small electric motor, fastened to one end of the base, using a stout cord for the belt. Place the wheel on a

stand or table near a wall outlet, so that you can plug in both motor and bulb from a double plug. Light a few candles, if it is a dinner party, switch off the room lights, and turn the rotating wheel. Your guests will be delighted at the novel lighting effect.



A Diabolo Is Fun to Make and Fly

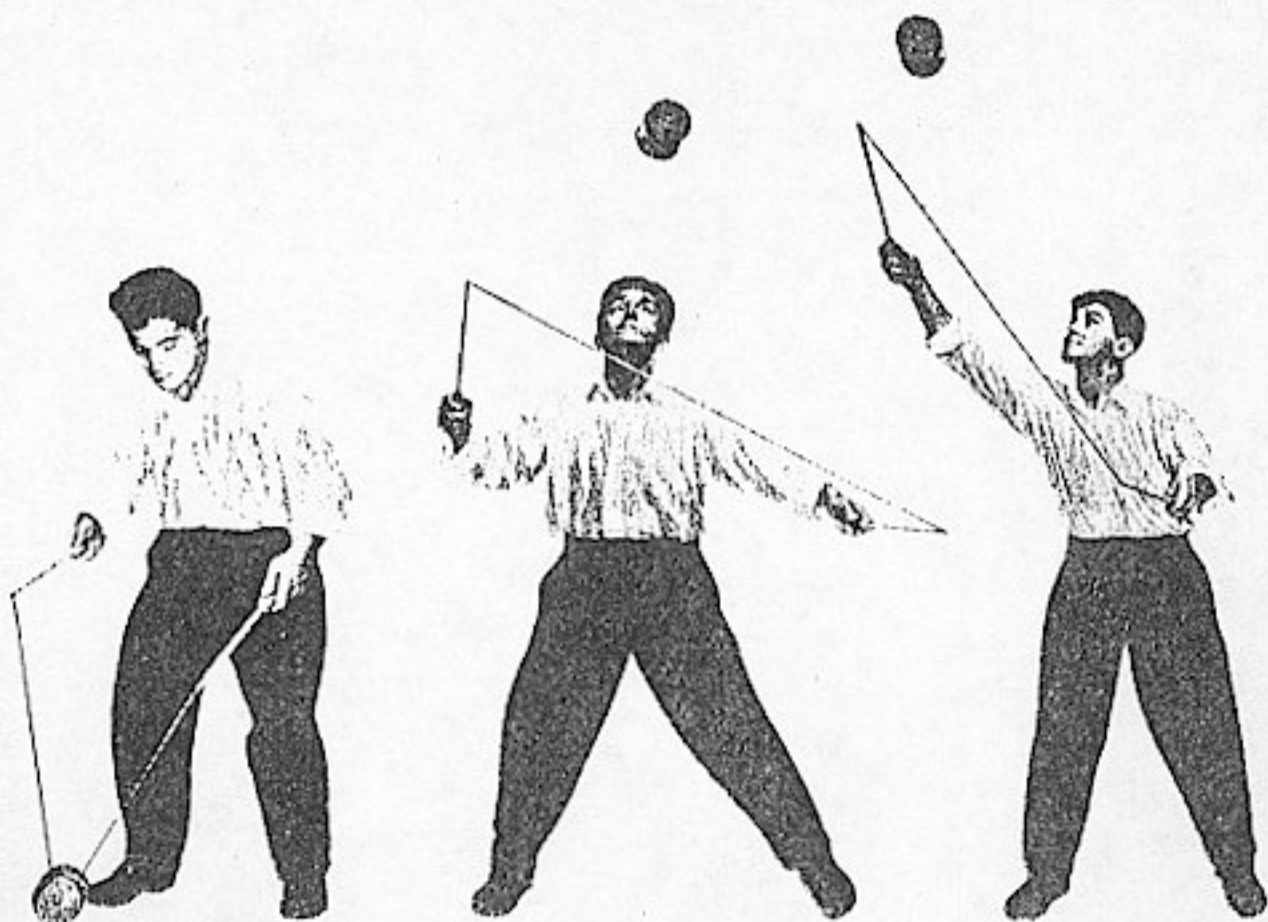


Popular Science Dec. 1955

TO SPIN THE TOP, you raise and lower the sticks alternately, with a quick backward shift of the string at the end of each rotating impulse.

When the speed is great enough to stabilize the top in flight, just whip the sticks apart to toss it into the air. As the spool comes down you catch it on a sloping string and let it roll down into slack bunched near one end.

Two diabolo twirlers can volley the spool between them; four can play a two-team game, racking points for longest volleys without a miss.



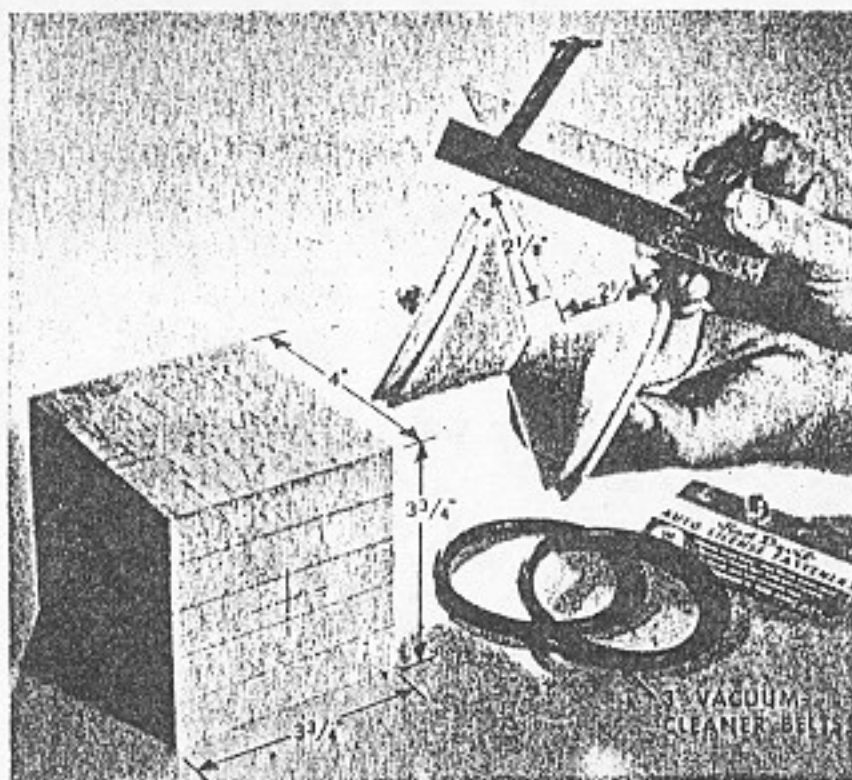
HERE is an unusual Christmas present for any youngster—a wasp-waisted diabolo top and the sticks and cord you need to spin and cast it high, wide and handsome through the air.

A game with a history, diabolo was popular with the ancient Chinese and with French sports of Napoleon's day before American youngsters turned it into a backyard fad from 1910 to 1915.

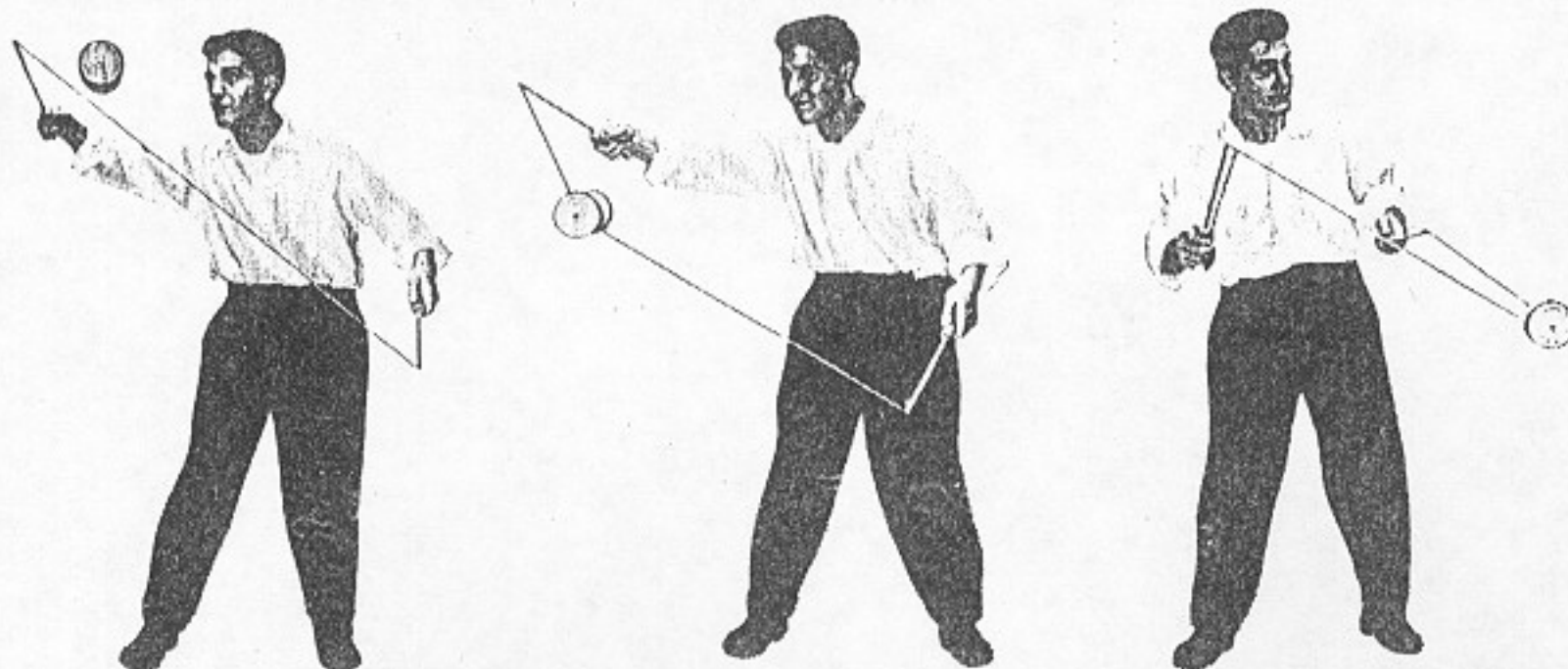
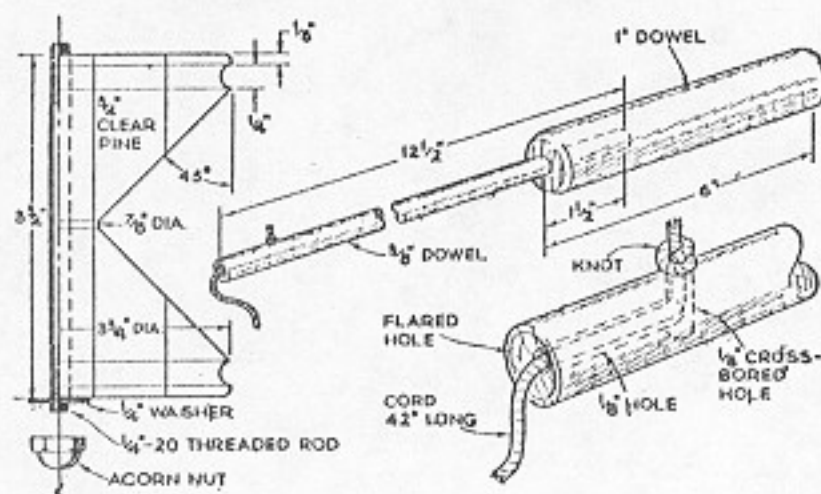
Considerably more skill is needed to twirl a diabolo top than the Yo-yo it resembles. The diabolo flies free and is caught before it falls to the ground.

The top shown here was patterned after an old-timer I found in an attic trunk. The 1956 model was made more stable by adding a balance-adjusting core, and easier on itself and indoor surroundings by placing rubber rings on the rims. These are 3"-diameter vacuum cleaner belts bought at a cleaner service shop. Acorn nuts, from a box of auto-license fasteners, cap the threaded core. To stabilize the top, you shift the threaded rod a bit to one side or the other with the nuts.

Rough out the spool with a skew chisel, finish with a V-point chisel. Face the ends close to the nuts on the mandrel. Chisel off the remainder. Glue $\frac{3}{8}$ " dowels into 1" dowel handles to make the sticks. Tie a 42" length of chalk line or heavy fishline to each pair. Make at least two pairs.—Stewart Rouse, Lewisville, Ind.

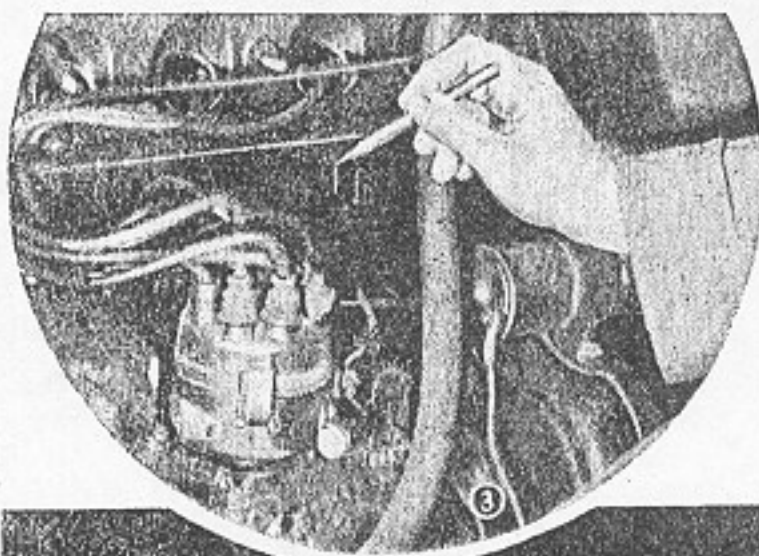


THE DIABOLO BLANK is $\frac{3}{4}$ " wood glued up as above. Drill a $\frac{1}{4}$ " hole through the center and insert a threaded rod. Lock the rod in place with nuts and washers and, using the rod as a mandrel, set the blank between lathe centers. Check the turning with a template made by clamping a steel rule across the 90° angle of a draftsman's triangle. After turning $\frac{1}{4}$ " end grooves for the vacuum cleaner belts, remove the nuts, sand off the ends of the spool and apply two coats of shellac. Shorten the rod and thread on balance-adjusting acorn nuts.



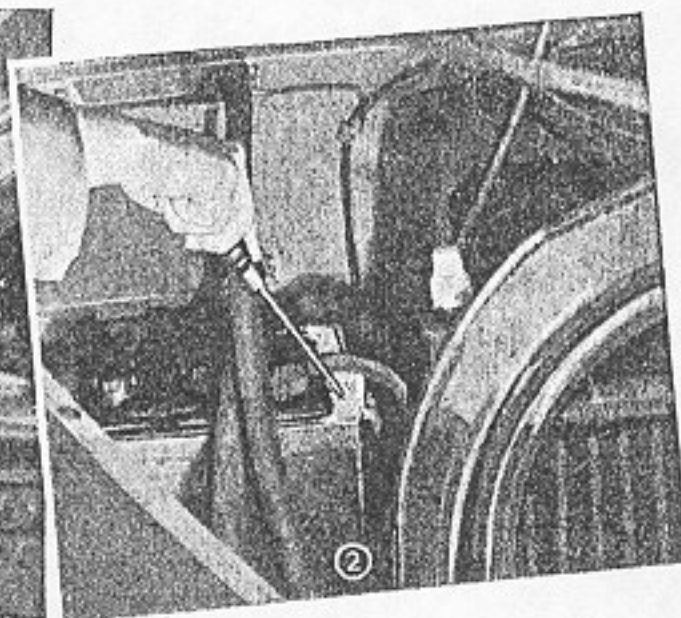


Exceptionally heavy oil often is used to help silence noisy and badly worn motors. Also, heavy oil is used frequently in order to minimize oil pumping and resulting troubles



A LEAKY RADIATOR MAY COST SEVERAL DOLLARS TO REPAIR

WHAT TO CHECK *where*



Appraising used cars for true values—what to look for and what you should avoid

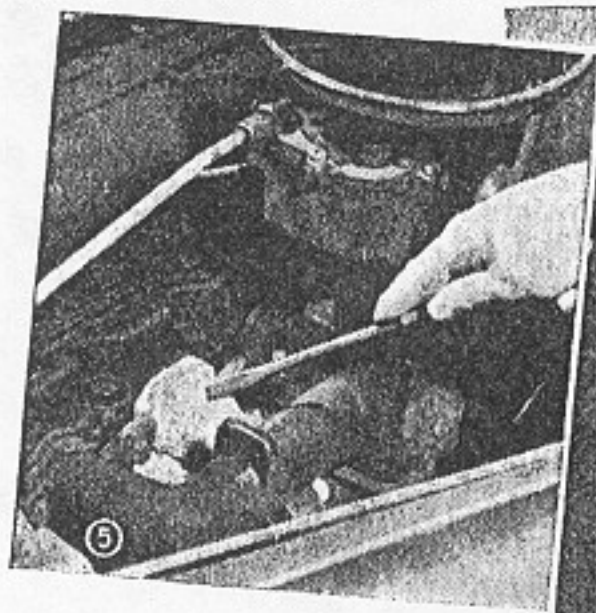
POPULAR MECHANICS, 1945

By James R. Ward

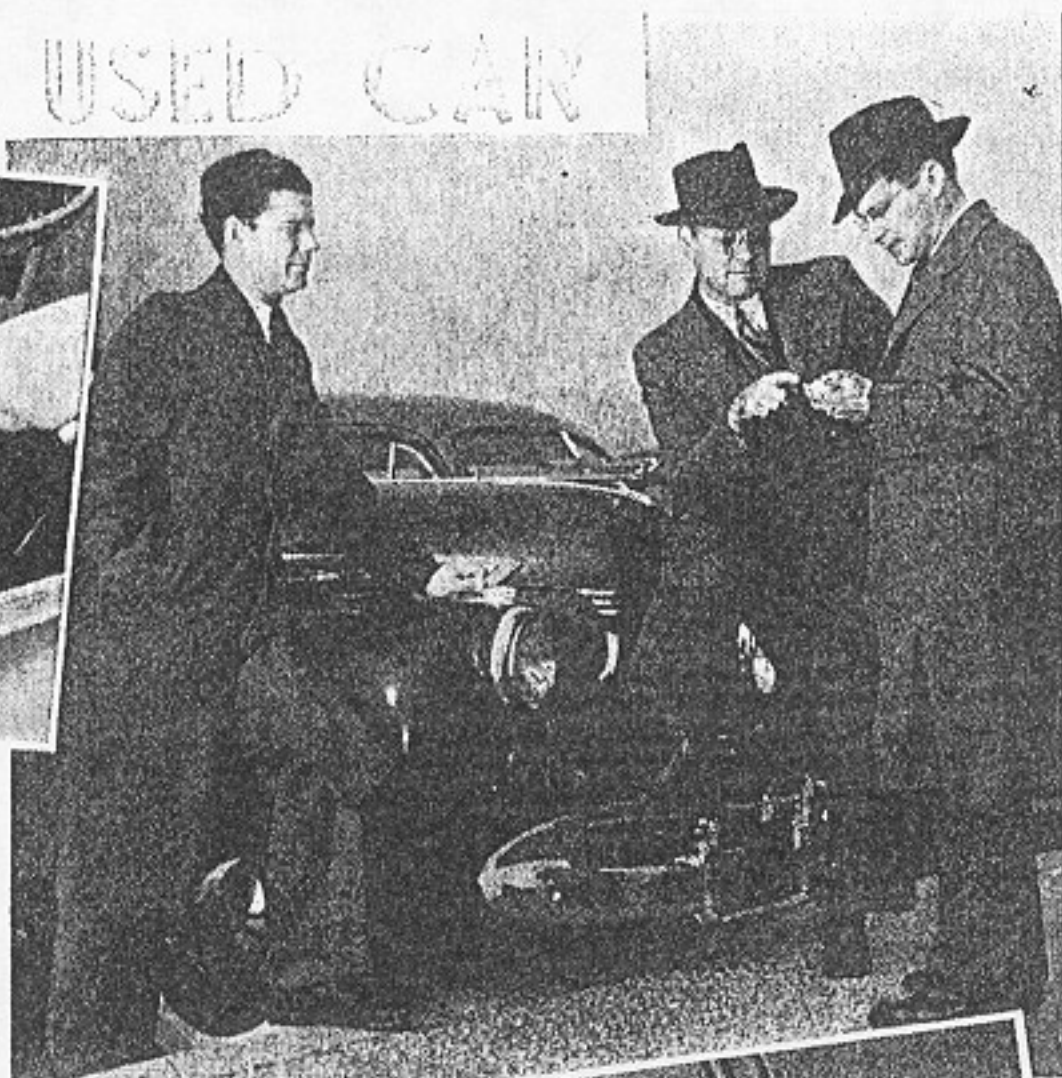
WHEN you cannot get a new car and you must resort to a used one, a good selection depends on how much you know about its mechanical condition, unless of course, you can enlist the services of a capable mechanic on whose judgment you can rely. There are a number of relatively simple checks by which poor values can be eliminated.

When going out to look at cars, don't become overly enthusiastic about any one until you have made such checks. Too often the good appearance of a new paint job entices the unwary buyer, but the careful buyer, apprehensive of true value, is more interested in the condition of the motor which will give him reasonably long service without expensive repairs. Also, many buyers depend on the speedometer reading as a criterion of wear. However, a high mileage record does not necessarily mean excessive wear of the motor. For instance, if a car, perhaps one driven by a salesman, has been driven continuously for long trips, and it has not been abused, the motor may be worn less than a car used for making innumerable short trips, such as in city driving. The reason for the difference in condition is that the long-run car was started less frequently and it is the lack of proper lubrication when starting, especially in cold weather, that wears off

BUYING A USED CAR

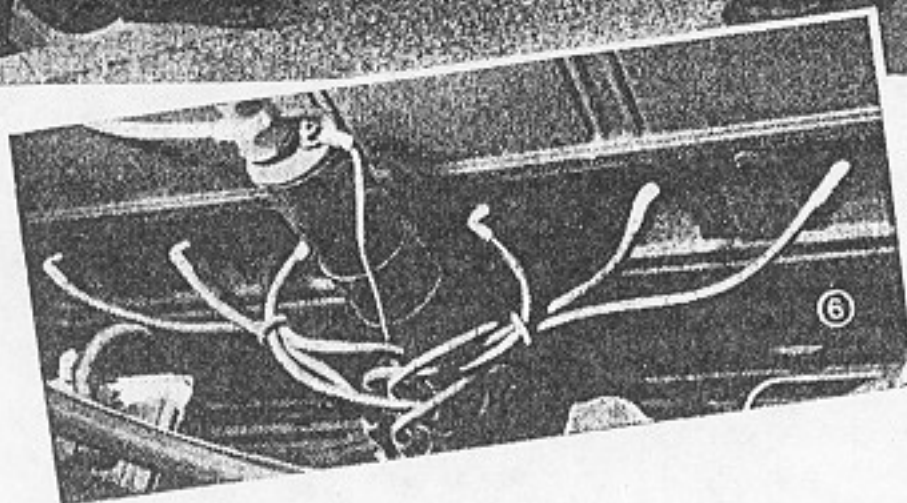


A cracked exhaust manifold, damaged gaskets between manifold and motor or other joints in the exhaust system may permit carbon-monoxide gas to enter the car

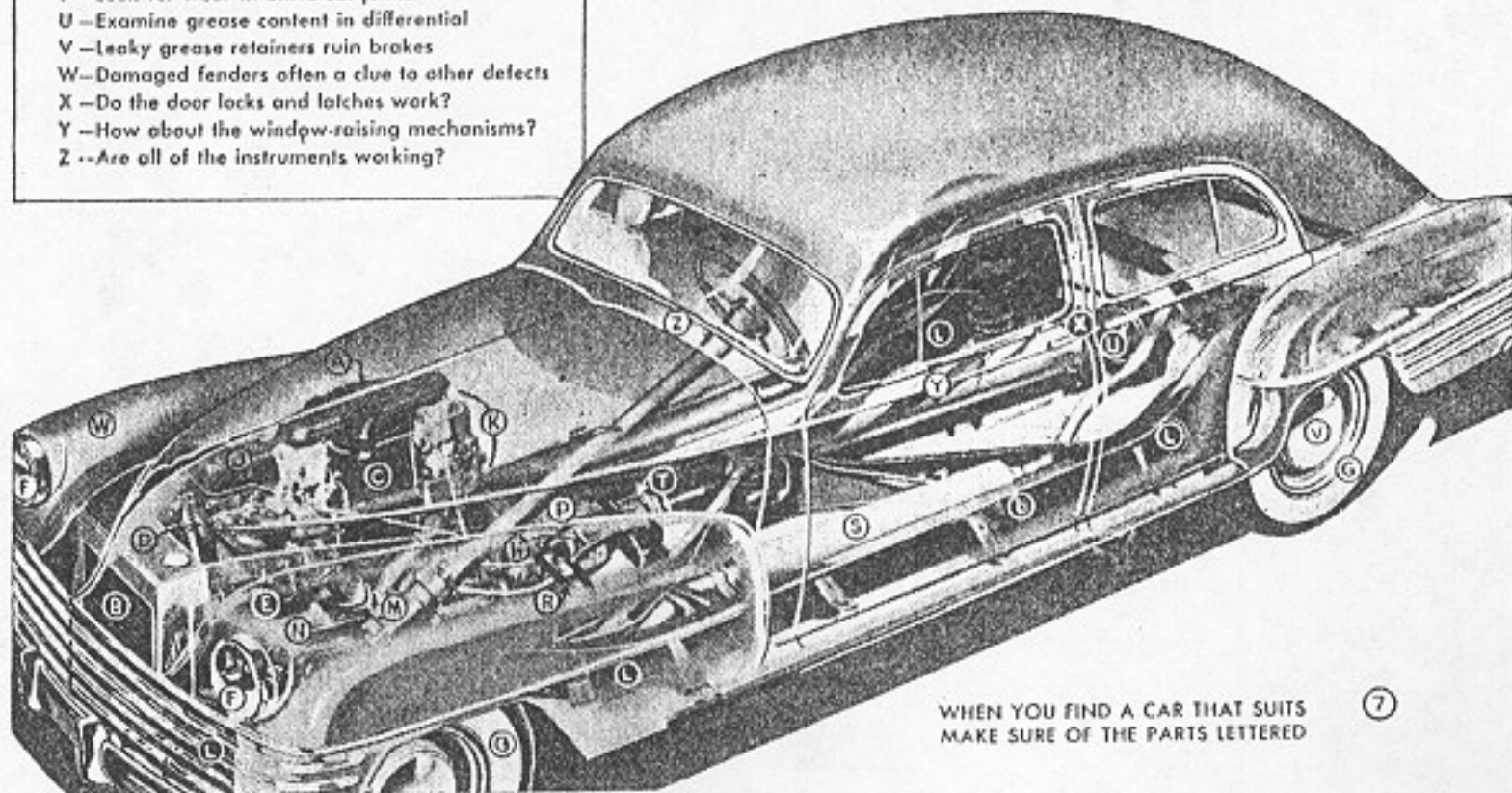


POINTS TO CHECK

- A—Is the battery in good condition?
- B—Is the radiator clogged or leaky?
- C—Look for cracked exhaust manifold
- D—Does water pump leak?
- E—Is the generator charging?
- F—Are headlamps in good condition?
- G—How about the tires?
- H—Check the clutch for grabbing
- J—Is motor noisy?
- K—Examine motor for cracks
- L—Has frame been damaged?
- M—A worn steering gear is dangerous
- N—The cylinder oil tells a story
- P—Watch for a leaky or noisy transmission
- R—Good brakes are essential
- S—Avoid a leaky exhaust system
- T—Look for wear in universal joints
- U—Examine grease content in differential
- V—Leaky grease retainers ruin brakes
- W—Damaged fenders often a clue to other defects
- X—Do the door locks and latches work?
- Y—How about the window-raising mechanisms?
- Z—Are all of the instruments working?



Rotted or frayed insulation on spark-plug cables and other high-tension wires will have to be replaced for good motor operation

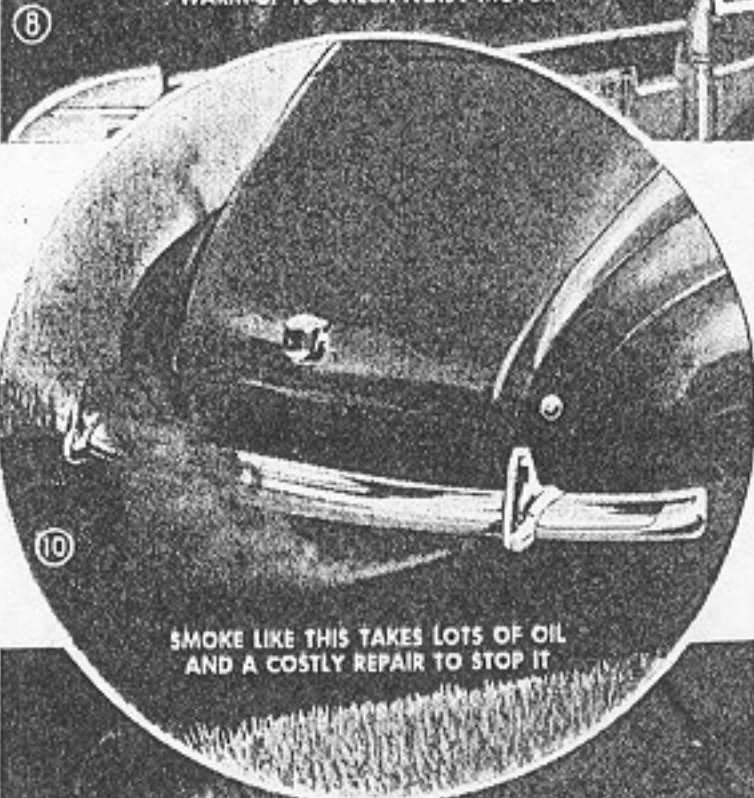


WHEN YOU FIND A CAR THAT SUITS
MAKE SURE OF THE PARTS LETTERED

7



COVERING RADIATOR GIVES QUICK WARM-UP TO CHECK NOISY MOTOR



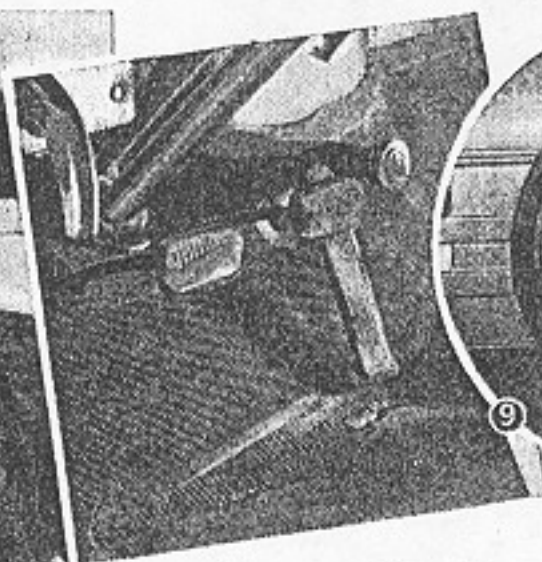
SMOKE LIKE THIS TAKES LOTS OF OIL AND A COSTLY REPAIR TO STOP IT



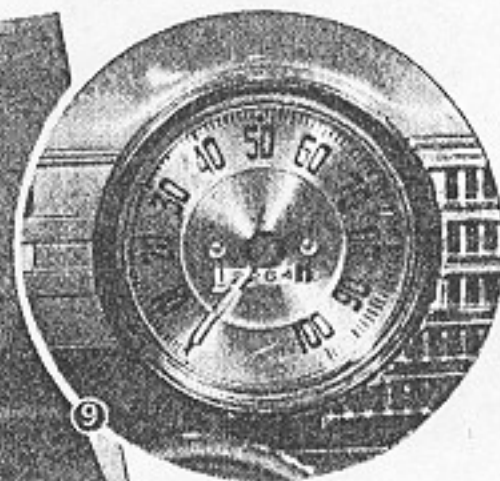
A DENT HERE MEANS A BAD BUMP



Evidences of repaired fenders may mean that the frame or front end of the car was damaged in an accident



Worn pedal pads and floor mat will belie the reading of a speedometer that has been set back to indicate a low mileage

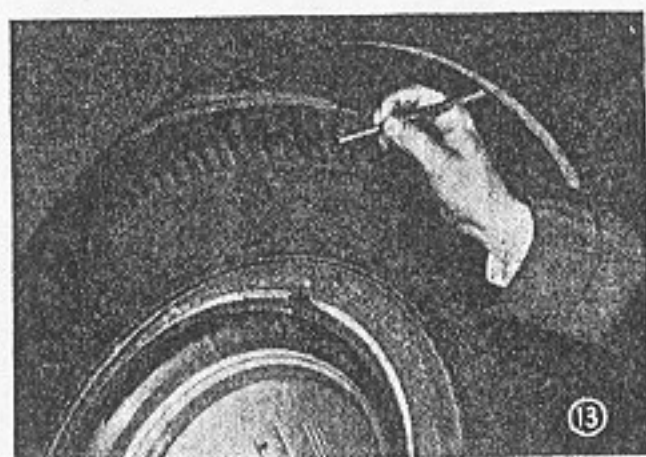


much more metal on moving parts than continued driving for many miles after oil has circulated to provide a protective coating on these parts.

As you go along from car to car you can make a few quick preliminary tests that will help eliminate the worst ones. As the oil is a good indicator of motor condition, raise the hood and look at the oil-gauge stick, Fig. 1. If it shows that the oil in the crankcase is exceptionally heavy, you can suspect that it was used to silence a noisy motor, or that the motor uses entirely too much oil of lighter viscosity, due to worn piston rings and cylinders. A strong odor of gasoline in the oil, and dirty black oil are also indications of worn piston rings, or worse, which will require an expensive repair job to correct. A thick coat of grime over the motor also means loss of oil, and likely ruined ignition wires, Fig. 6.

While the hood is raised, glance at the battery, Fig. 2. Often a carrier or hold-down frame covered with fresh corrosion indicates an old battery at least, and maybe a cracked one. Look at the battery cable to see if the insulation is worn off, and check for indications of cracks in the motor, Fig. 3. Examine the exhaust manifold, Fig. 5, for cracks that might fill the car with dangerous carbon monoxide gas. Glance at the fire wall where the radiator brace rods enter, Fig. 11. If there is a dent at this point, it was likely put there in a wreck. Check the radiator for leaks, Fig. 4. Run the tips of your fingers over the fenders, Fig. 12. Small bumps may indicate a repaired fender; then you should be on the alert for a bent frame or front end.

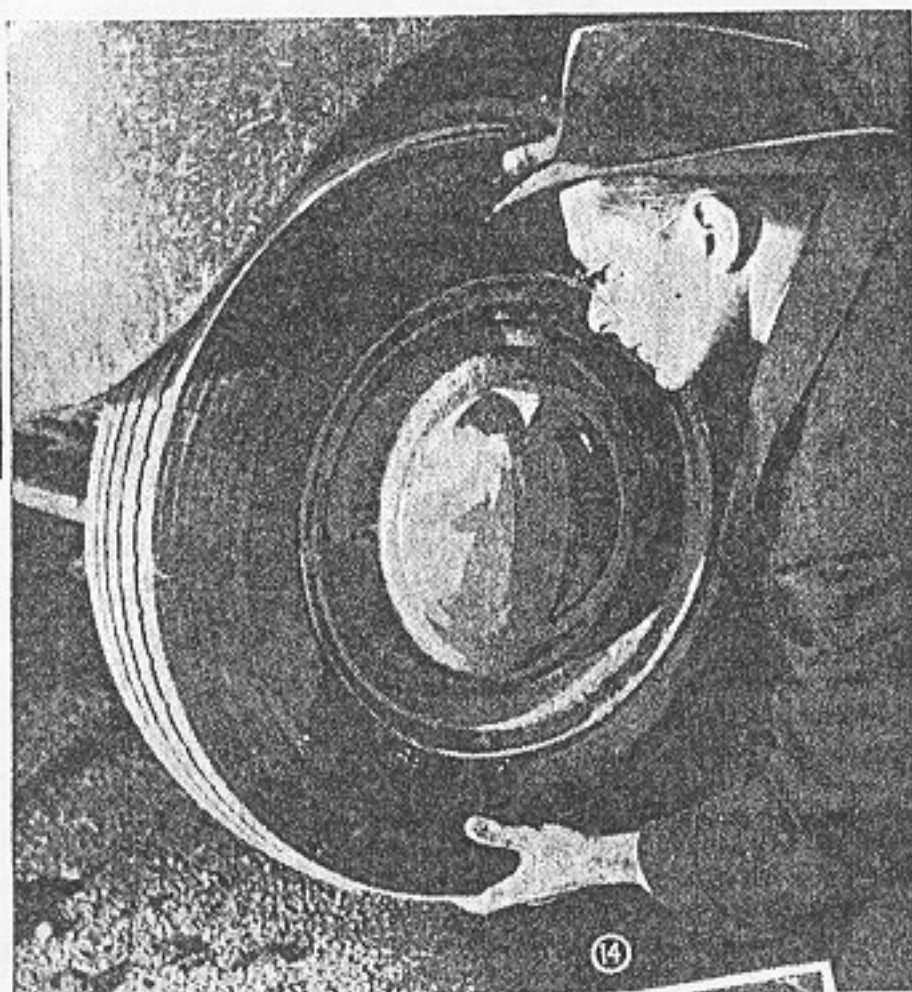
When you open the door, examine the edges, Fig. 18, to see if the car has been



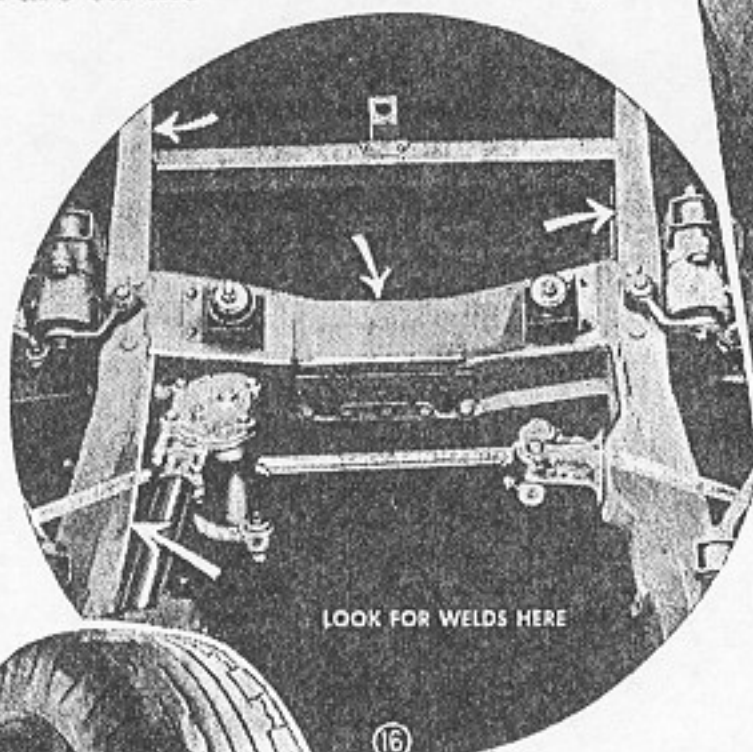
repainted. An undercoat of paint of different color than that on the body usually shows up here. Sometimes old taxicabs are repainted and sold as used cars. Good upholstery cloth, Fig. 19, and floor mats are a fair indication that the previous owner has given the car good care. Don't be misled by a low speedometer reading. Speedometers are often set back several thousand miles, sometimes to zero. Wear on the pedal pads and floor mat may contradict the reading of a speedometer that has been set back. For example, notice the speedometer, pedals and floor mat in Fig. 9. All are on the same car, but it took a lot more driving than the mileage indicates to wear the pedals and mat as shown—at least 20,000 miles.

Next, look at the front tires as they

Excessive wear on the front tires is a good indication that something is mechanically wrong with the frame or front end



Rocking the front wheel when the car is on a jack will give you an idea of the condition of the spindle bushings

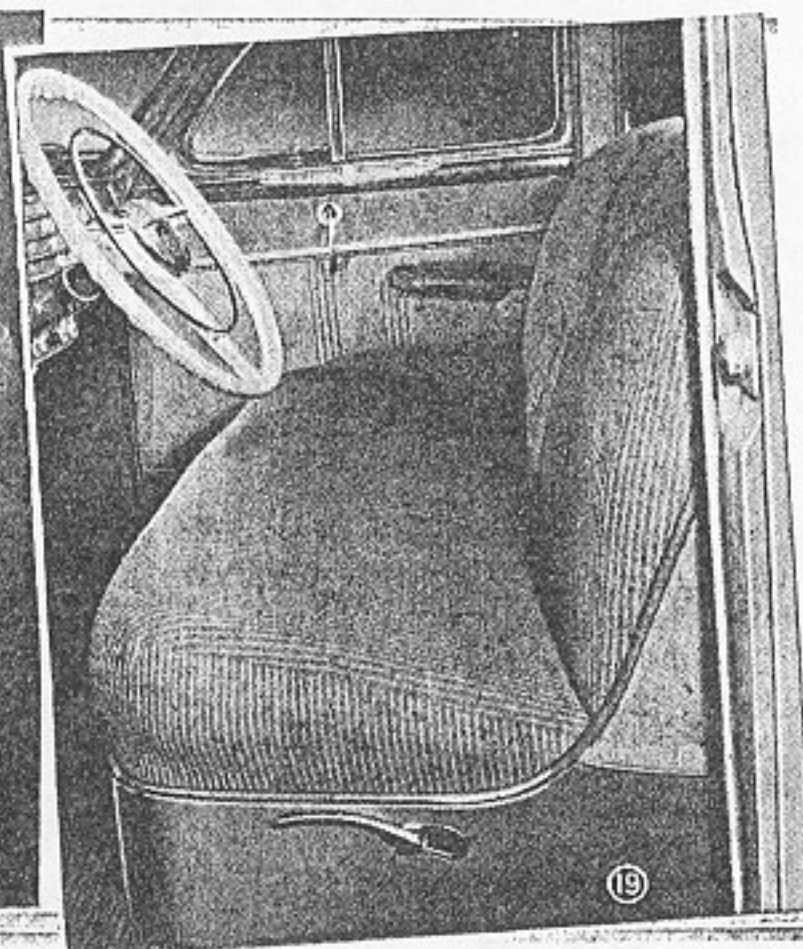


If the tires have been regrooved, check to see if grooves have been cut too deeply into the fabric. Also, be on the alert for a frame that has been repaired as the car may have been in a bad wreck



are a good, quick "barometer" to the condition of the front end. The photo of the one on the left in Fig. 17 indicates wrong toe-in or toe-out, which is remedied easily. But the one on the right shows that something is wrong mechanically that might be quite expensive to repair.

Now that simple preliminary checking has enabled you to examine several cars in a comparatively short time, and to



"weed" out the bad ones, pick out the most suitable one for further testing. You may find several minor faults that the dealer may be willing to repair before you buy the car, which he would not do after the car has been delivered. When you are ready to make further tests on the car, notice the salesman's attitude. If he is hesitant about you checking further, or if he tries to distract your attention at this time, you should be doubly thorough in the rest of the checking as he may know of some serious defect. Any salesman who has nothing to hide will be glad to cooperate with you in making further tests.

The tires are of great importance. Have they been regrooved, Fig. 15, and was a good job done? If they are worn, are there any breaks in the carcass that would make them unsuitable for retreading, Fig. 13? Jack up the front wheels and check for wear in the spindle bushings, Fig. 14. Too much looseness here may cause the tires to wear rapidly, or the wheels to shimmy on the road. While the car is on the jack, slip on a frock and crawl under the front end. Look for evidences of welding or straightening of the frame, especially at the points indicated by the arrows in Fig. 16. If any are found, it is likely that the car has been in a wreck. Usually you are taking too much chance in buying such a car, because subsequent wear of parts out of alignment may not be evident yet, but

will show up later. Also, misalignment at certain points of the frame will give you nothing but grief.

If everything is all right so far, you are ready to give the car a road test. As the motor should be heated to the proper operating temperature, you can save time by putting a blanket over the radiator before starting as in Fig. 8. Leave it on just long enough to get the temperature indicator pointing in the normal range. While traveling on a smooth, level street at a speed of about 25 m.p.h., let loose of the wheel. The car should travel at least 300 ft. without a tendency to pull toward one side; otherwise the front end needs attention—perhaps only adjusting. Also, see if there is excessive looseness in the steering gear and linkages. Next, pick a rough street and test the car for riding. Be sure to use the brakes too, both at high speed and at low speed, noticing if there is a tendency of the car to pull toward the side when the brakes are applied. If the motor has reached driving temperature by this time, accelerate rapidly and then decelerate quickly. Then, if considerable bluish-grey smoke pours out of the exhaust pipe as in Fig. 10, the car is an "oil burner," in which case it will need an expensive job of new piston rings, and perhaps reboring of cylinders. However, if the smoke is black, it may need only a carburetor adjustment.

With the motor hot and the oil thinned

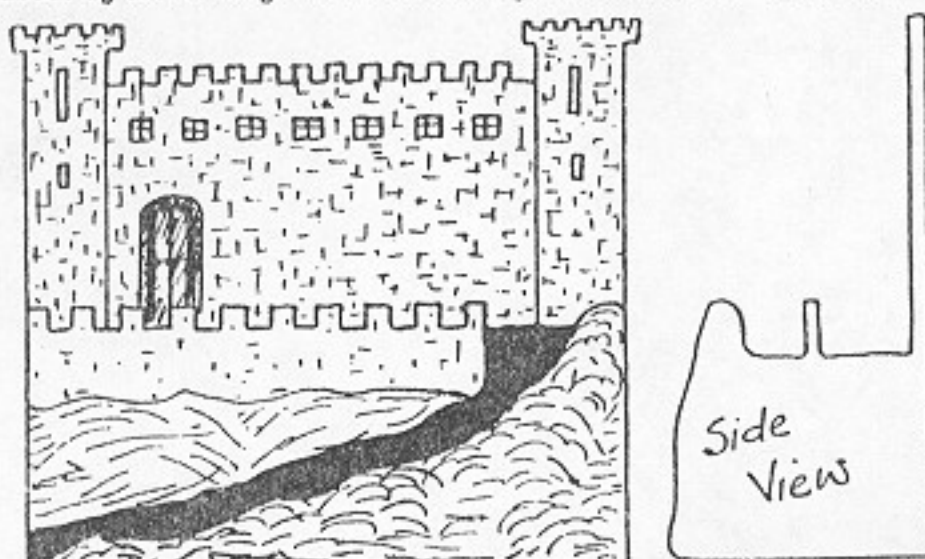
down, any noise in the motor will be evident, which indicates wear. While driving, listen for growling or humming noises in the transmission and differential. Accelerate rapidly and progressively at all three gearshifts and listen for any indication of wear. Now refer to the table at the left of Fig. 6, and thoroughly check all the points indicated in Fig. 7 that have not been checked already. Be sure to examine the grease in both the transmission and differential. Sometimes cereal, ground cork and other materials are added to silence badly worn gears and bearings. Although some of the points indicated to check are only minor, a number of small repairs may involve considerable expense, and influence your decision.

A TOY FORT

A toy fort provides lots of fun if you have an army of tin soldiers with one or two guns on wheels. The best material with which to make it is thin fretwood for the frame, and whitening mixed with glue for the moulded parts.

A simple design is given as a pattern, but it may be altered, of course,

if desired. If the present design is followed the frontage should be about 15 inches long and the total height about a foot. Although the



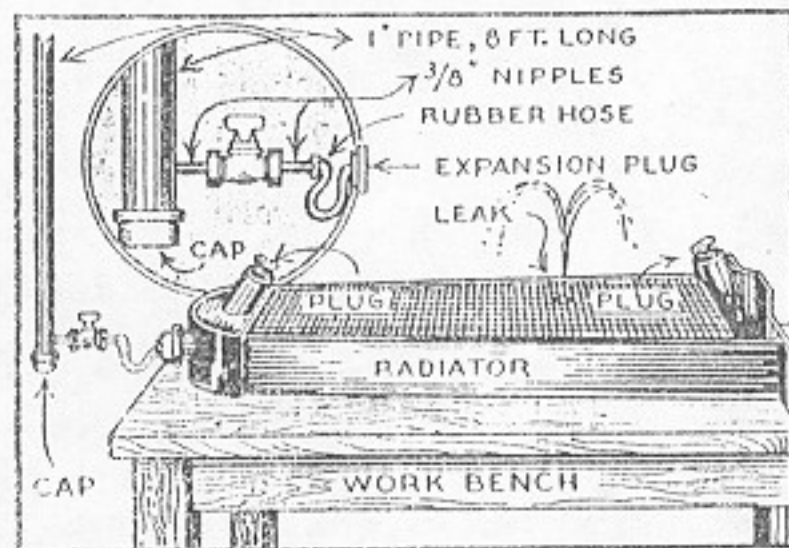
frontage suggests a square building, the remaining three sides need not be added unless a store place is required for the miniature army.

In front of the building is a terrace 3 inches wide, and then comes a castellated wall with an inclined roadway running down to the level of the surrounding land.

When the pieces of wood have been cut with a fret-saw and nailed together some whitening is mixed with hot glue and spread over the parts that are required to be unevenly modelled, such as the grassy embankments at the side of the sloping roadway.

The last stage is the colouring, which may be done readily with oils or paints of the cellulose type.

TESTING LEAKING RADIATOR



Instead of lifting a heavy radiator in and out of water when testing it for leaks with air pressure, a mechanic saves this work by using a column of water in a 1-in. pipe to produce the pressure. This enables him to place a radiator on a bench, locate the leak and solder it without moving the radiator. The inlet, outlet and overflow of the radiator must be plugged. If water interferes while soldering, it can be removed by taking out one of the plugs. Use of an expansion plug for the filler hole will permit quick attachment to various radiators. Water in an 8-ft. length of 1-in. pipe set



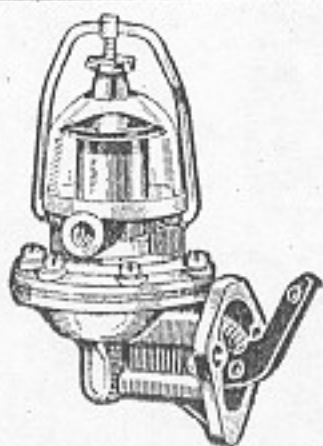
vertically will produce a pressure of about $3\frac{1}{2}$ lbs., which is enough to locate most leaks. It is necessary to refill the pipe after each test to maintain the pressure.



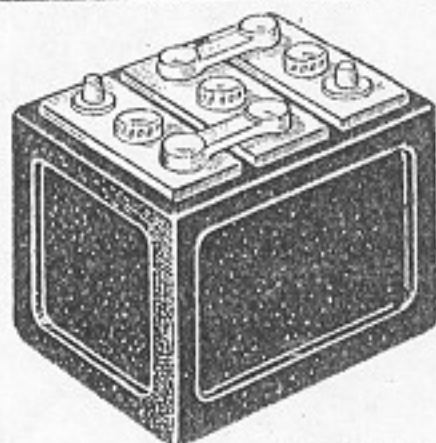
Give Your Engine

AIR CLEANER choked with dirt saps engine power and wastes gas. Remove the filter element and wash thoroughly in gasoline. Then dip it in light oil and allow it to drain before replacing. Make sure connections from cleaner to carburetor are leakproof. Watch oil level in oil-bath type cleaners

POPULAR MECHANICS, 1948



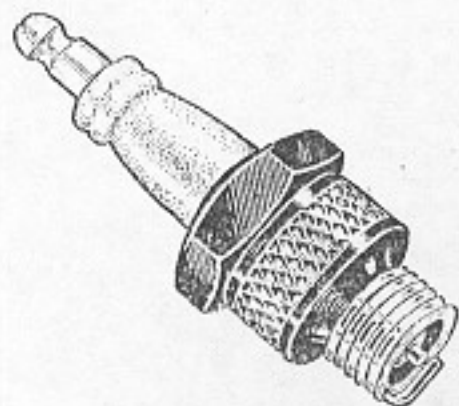
FUEL PUMP sediment bowl must be emptied of water and dirt regularly. Check the pump diaphragm, too. Sudden increase in oil consumption may indicate broken diaphragm is sucking engine oil from crankcase. If flow of fuel is weak, blow out the line with an air hose held at fuel pump (remove tank filler cap first), and check the line back to the tank for flattened spots



BATTERY neglect means short life. Check regularly at least once every two weeks and even more often in hot weather. Inspect each cell to see that water level is above plates at all times, and add only pure distilled water when needed. If terminals are corroded, scrape them clean and coat with vaseline. Soda-water application neutralizes acid on top of battery



DISTRIBUTOR check should cover inspection of housing for cracks that may retain moisture and develop shorts; cleaning sockets where high-tension wires enter the cap, and smoothing pitted points. Remove oil deposits, if any, and locate source, as oil on breaker points will cause excessive point burning. Over-oiled rotor wick or oil from grease cup may be the trouble



SPARK PLUGS fail in four ways: normal wear, broken insulators, dirty electrodes and excessive gap. Do not screw plugs tightly in place; future removal of a "frozen" plug may result in cracking the insulator. Scrape accumulated carbon from electrodes and check for excessive gap between them. In regapping, use a feeler gauge and always bend side electrode

a "Physical" Check-up!

Minor things that you can do yourself to save both time and money and keep your car operating at top efficiency

By Phil Ruskin

AN HOUR or two spent occasionally in making minor adjustments and repairs on your car engine not only will be repaid in the pleasure of driving a car that gives peak performance, but also will help delay the time for a major overhaul job. Efficient fuel and ignition systems, Fig. 4, are a must if an engine is to deliver its power smoothly and economically, so start the check with the fuel system.

Fuel pump: This is the heart of the system and should be checked first. Disconnect the fuel line on the discharge side of the pump. Then turn the engine over a few times with the ignition off to see if the pump is delivering sufficient gas. If the flow is insufficient, blow out the fuel line and clean the pump sediment bowl. Be sure the tank vent is open. A weak flow of gas may indicate that the trouble is in the fuel pump itself.

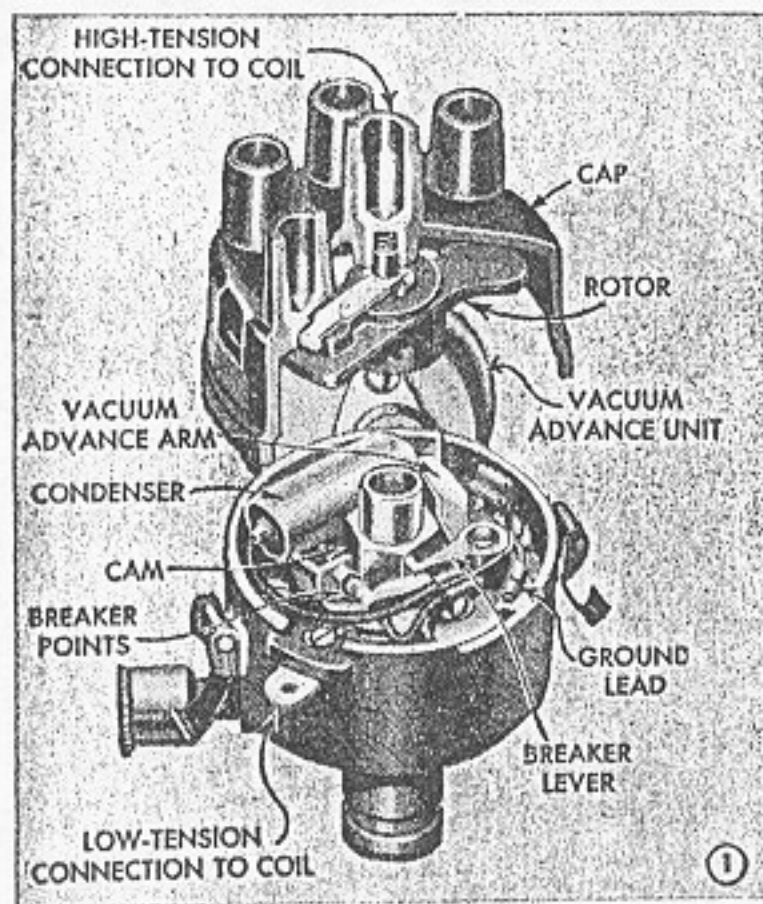
Carburetor: Aside from fuel pump failure, improper functioning of the carburetor is another primary cause of poor engine performance. Check the float and needle valve to see that the latter seats properly and that the fuel level is maintained at the correct height in the float chamber. This varies with the different cars. The correct level recommended for each individual make of car can be had by consulting a dealer or manual. However, in the absence of this information, the correct level can be determined, to some extent, in the following way: When the fuel level is too high, the carburetor will be flooded when the engine is not running. If it is too low, the engine will perform poorly, especially when attempting rapid acceleration. Be sure that all vents and jets in the carburetor are open and in working condition. Set all manual adjusting screws to give the best engine rhythm when it is idling at a speed equivalent to 20 m.p.h. If the engine has an automatic choke, be sure that it remains closed when the engine is



cold, and open when the engine is warm. All gaskets around the carburetor must be leakproof. Engine idling should be adjusted to the lowest speed at which the engine will turn over smoothly. Some carburetors have a screen in the inlet pipe that requires periodic cleaning.

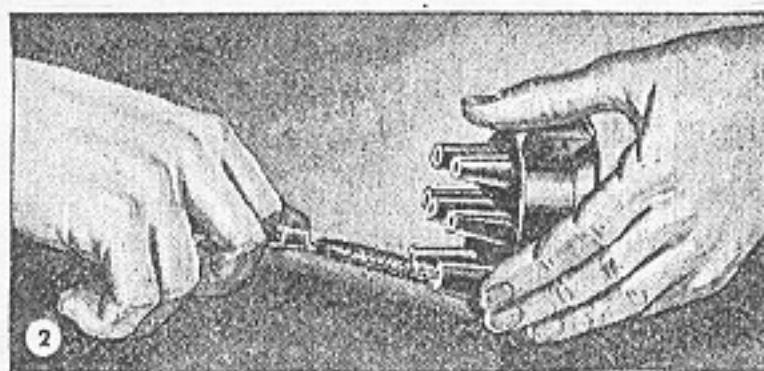
Air cleaner: A partially blocked air cleaner causes excessive fuel consumption and may be the cause of a sluggish engine. Remove the cleaner and wash all parts in gasoline. Recoil the copper-gauze filter and allow it to drain before replacing. If the air cleaner is an oil-bath type, refill the reservoir to the level mark. This usually requires about a pint of oil.

Battery: A faulty ignition system will cause an otherwise good engine to run poorly. Test the battery and see that the electrolyte covers the plates at least $\frac{3}{8}$ in. A fully charged battery should have a specific gravity reading of 1.280 and should never be allowed to fall below 1.250. Clean the corrosion from the terminals with a wire brush and wash the top of the battery with a solution of baking soda, rinse off with warm water and wipe dry. An application of grease or petroleum jelly to the terminals will help prevent corrosion. It's especially important that the ground cable connections be tight and clean. Replace broken and frayed battery cables. With the battery in good shape, ample voltage is assured. Next comes the ignition coil. It's best to have it tested at a garage, but you can make a fair test by pulling the high tension wire from the center of the



distributor and holding it $\frac{3}{8}$ to $\frac{1}{2}$ in. from the motor. If a spark jumps to the motor when the distributor points are broken, likely the coil is all right.

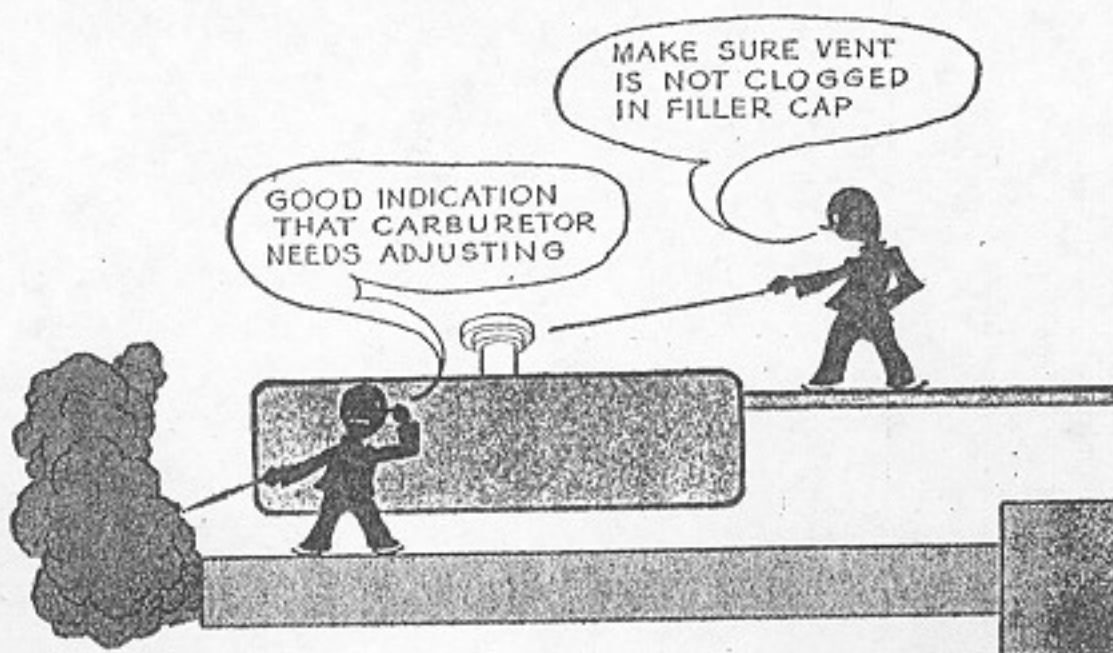
Distributor: Check to see that it is clean, that all parts are lubricated, Fig. 1, that the casing is not cracked and that the springs are in good condition. Also see that the breaker points are not unduly pitted and are timed perfectly. If the points are pitted slightly, use a coil file to smooth them. Or, better still, replace them. Badly pitted points that produce a long, hot arc when they break with the ignition on usually indicate a weak condenser. If this condition is apparent, both the points and condenser should be replaced. A mark on the flywheel of most cars permits timing the points to a close degree of approximation without the use of an instrument. When the mark is centered in an index hole in the housing, the points should begin to break for firing the No. 1 cylinder. Check with a dealer to obtain the correct firing order of the engine and the gap required between the breaker points when they are wide open. Use a regular feeler gauge to test the clearance. If the timing of the cam in the distributor is off, it can be adjusted by loosening the distributor on its shaft and turning it until the correct moment of "point breaking" is found. Check the ignition wires for breaks in the insulation, wipe them clean of oil and dirt and see that they do



not come in contact with hot engine parts. Also, it's a good idea to clean and polish the wire sockets in the distributor as in Fig. 2.

Spark plugs: Before removing the spark plugs, clean the walls around them so that dirt will not fall into the cylinder. Look for cracks in the porcelain insulation and adjust the electrodes, Fig. 3, to a gap of .025 to .029 depending on the maker's instructions. Adjust only the side electrode, never the center one. If the electrodes are badly burned, or if the plugs are very dirty and rusted, replace them. In replacing the plugs tighten them just snugly, do not draw them up tightly. The right type plug to install is important. Where you notice that the insulators of the plugs become a brownish color quickly and the electrodes burn away, they should be replaced with a cooler running plug having a short shank. If the plugs are wet, sooty and fouled all the time, a hotter running plug—one with a long shank—is needed.

Road test: When the tests so far have been made, give the car a road test. You may find the carburetor needs adjusting. If the engine "rolls" or it seems sluggish and black smoke pours from the exhaust following rapid acceleration, the carburetor mixture is probably too rich, that is, too much fuel in proportion to air. On the other hand, if the engine "spits" and lacks power, the mixture is perhaps too lean. During the road test, try hill climbing. Here you may find that the spark is

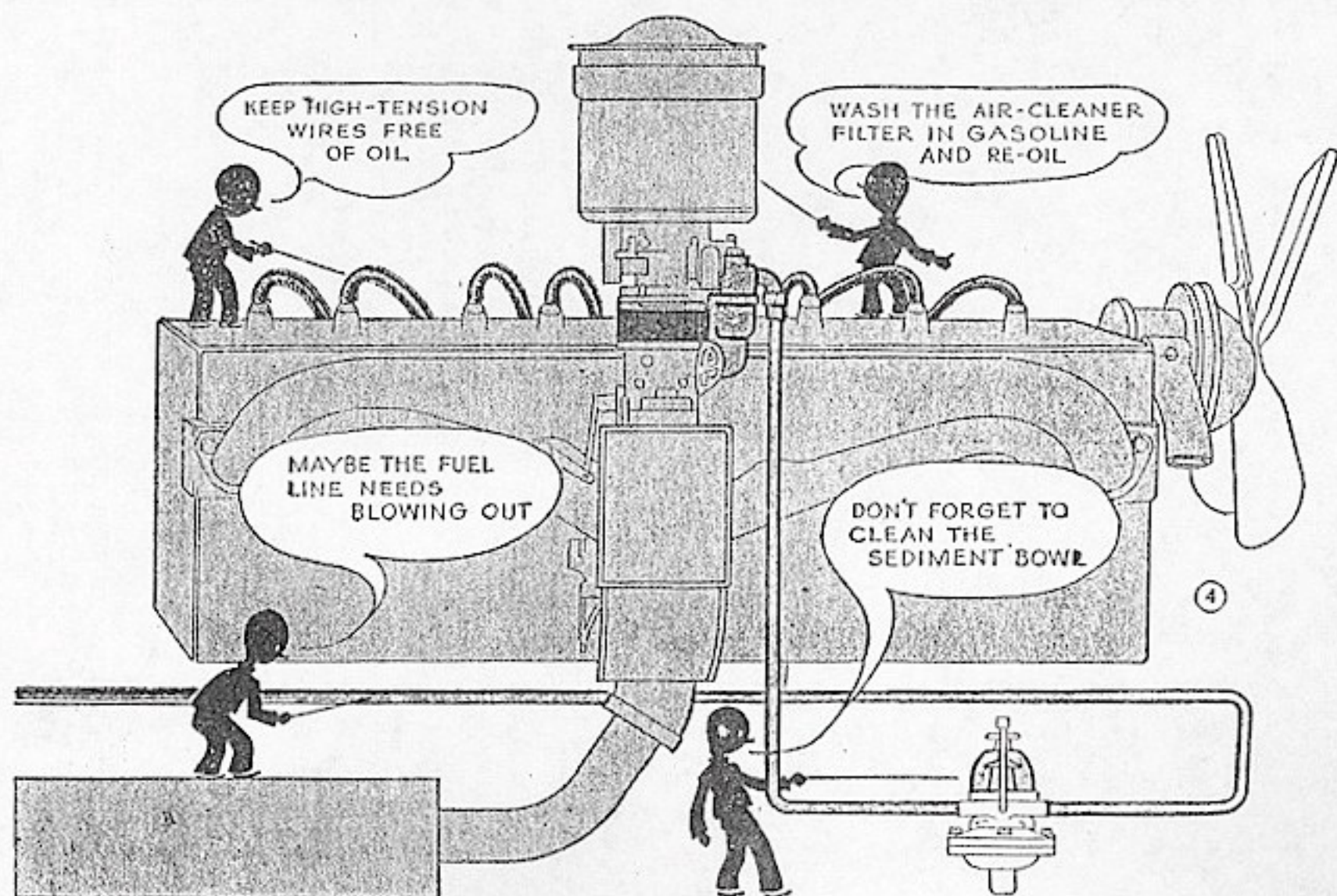


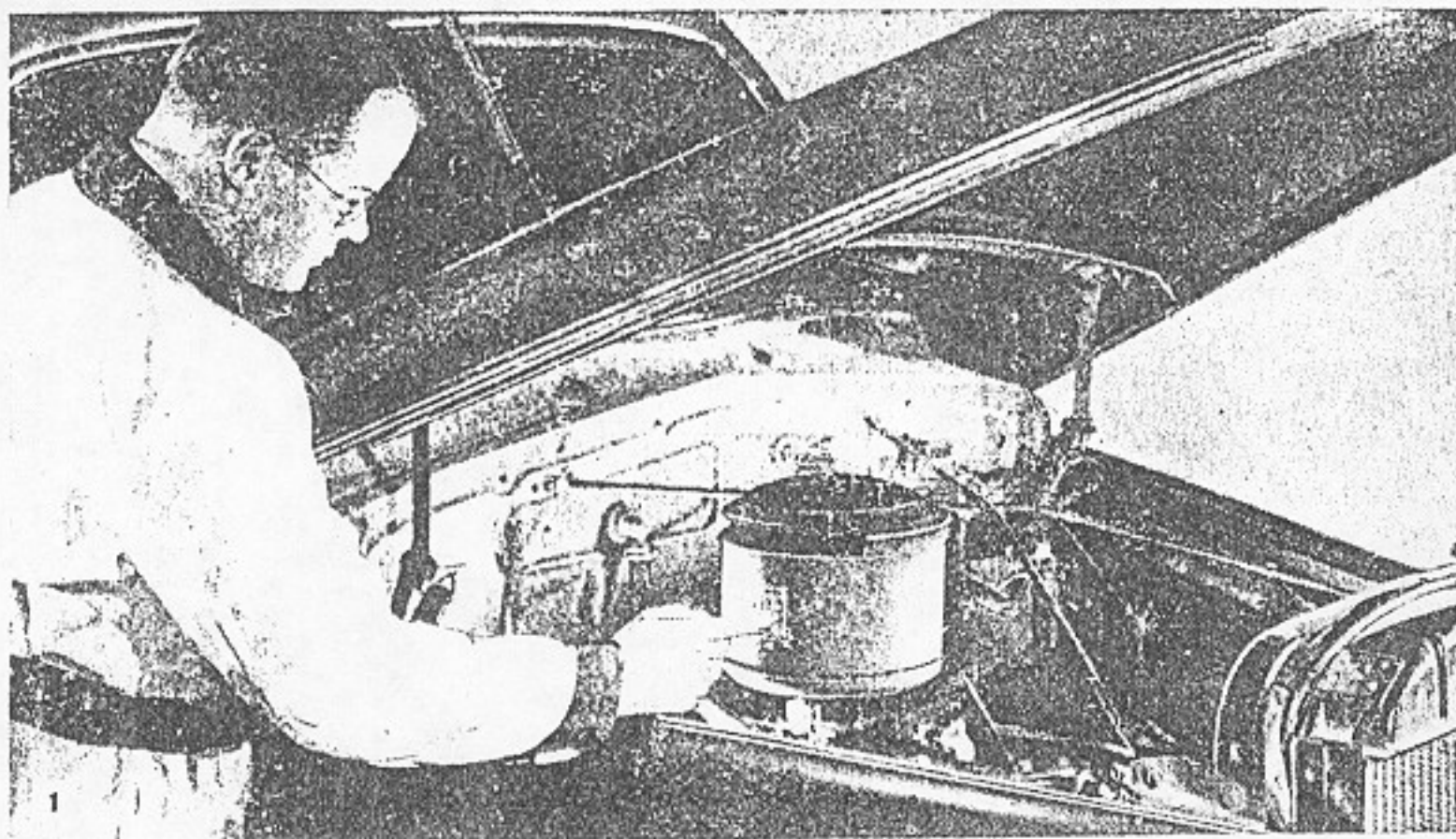
advanced too much for the type of fuel being used, causing the engine to knock and lose power. Recheck distributor and spark plug gap. Also, check engine compression by letting the engine idle downhill in high gear. Good compression should hold the car back fairly well. On level grade a good six-cylinder engine should be able to pull evenly at less than 5 m.p.h. in high gear. Another thing to check is the condition of the piston rings and cylinder walls. If blue smoke is observed from the exhaust during fast acceleration, it indicates that lubricating oil is passing the pistons, and the rings or cylinder walls need attention.

Engine compression: If the engine still performs poorly, look for faulty compression. First check the valve clearance with a feeler gauge placed between the valve stem and the actuating mechanism when the valve is fully closed on its seat. Examine the condition of the valve springs too. Testing engine compression accurately requires a special gauge, but by removing the plugs, one at a time, and holding the hand over the plug opening while the engine is being turned over, you'll be able to detect a weak cylinder. Another way is to "short" one or a pair of spark plugs while the engine is running. A weak cylinder will show very little if any decrease in engine speed when it is shorted out, which indicates that it is doing little work. A

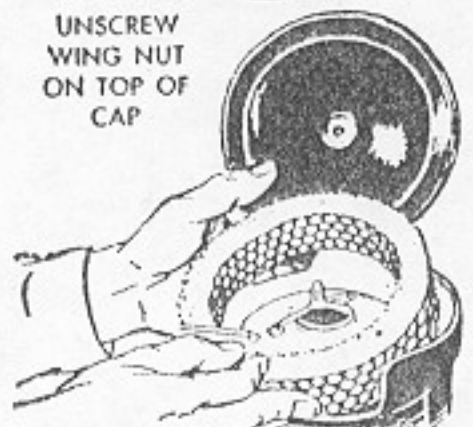


third method of finding a weak cylinder is to crank the engine over slowly by hand, and count each cylinder as it comes up on its compression stroke. Less compression in cranking will be noted if a cylinder is weak. If regrinding the valves makes no appreciable improvement in compression, the pistons and cylinder walls need attention. This, however, amounts to a major overhaul job which should be done by a competent mechanic. Finally, it's a good idea to check the engine temperature during tests. If the cooling system is in good condition it will remain fairly constant.





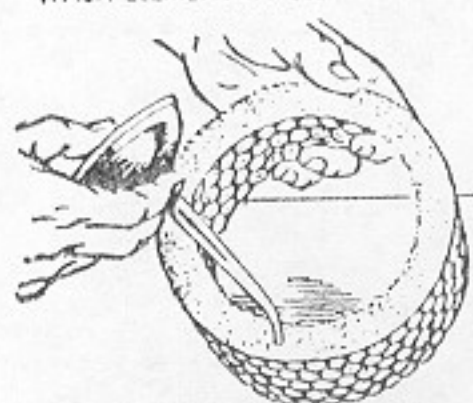
UNSCREW
WING NUT
ON TOP OF
CAP



REMOVE AIR FILTERING ELEMENT



WASH ELEMENT IN CLEANING FLUID



OIL FILTER AND REPLACE

MOTOR TUNE-UP

Learn to make quick checks of general engine mechanical condition, and how to keep your repair costs at a minimum. This informative story on engine tune-up shows you what to do to keep fuel, compression and ignition systems in top condition

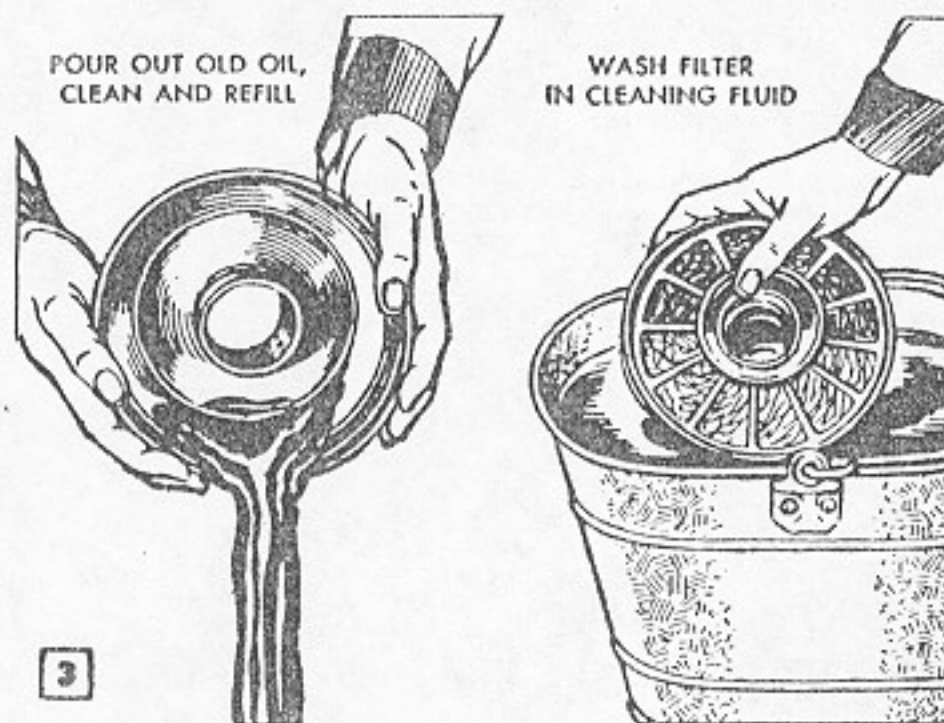
Fuel and Exhaust System

AUTO SERVICEMEN regard periodic engine tune-up as the most important single item in car care. Regular tune-up keeps the engine performing at top efficiency, resulting in minimum wear, maximum fuel mileage and greatly reduced repair costs. As a rule, a regular tune-up job begins with the fuel system, Fig. 1, the purpose of which is to combine fuel and air in the correct proportions at varying engine speeds, loads and temperatures. A badly clogged air-cleaner element can have the same effect on fuel consumption as driving with the choke in a partly closed position. It's easy to disassemble the air cleaner and just as easy to clean it by proceeding as in Fig. 2. Always recoil the filter element before replacing it. To clean the oil-bath type of air cleaner, you proceed in much the same way except that generally the entire unit must be removed so that the oil in the reservoir can be drained out and the reservoir washed thoroughly with white gasoline or a suitable cleaning fluid, Fig. 3. When replacing the unit, refill the reservoir with clean engine oil to the level indicated. Be sure all parts are replaced in the proper position and that wing nuts and bolts are tightened to the correct tension. After replacing the air cleaner, make sure that the tightening clamp does not bind the choke blade or shaft.

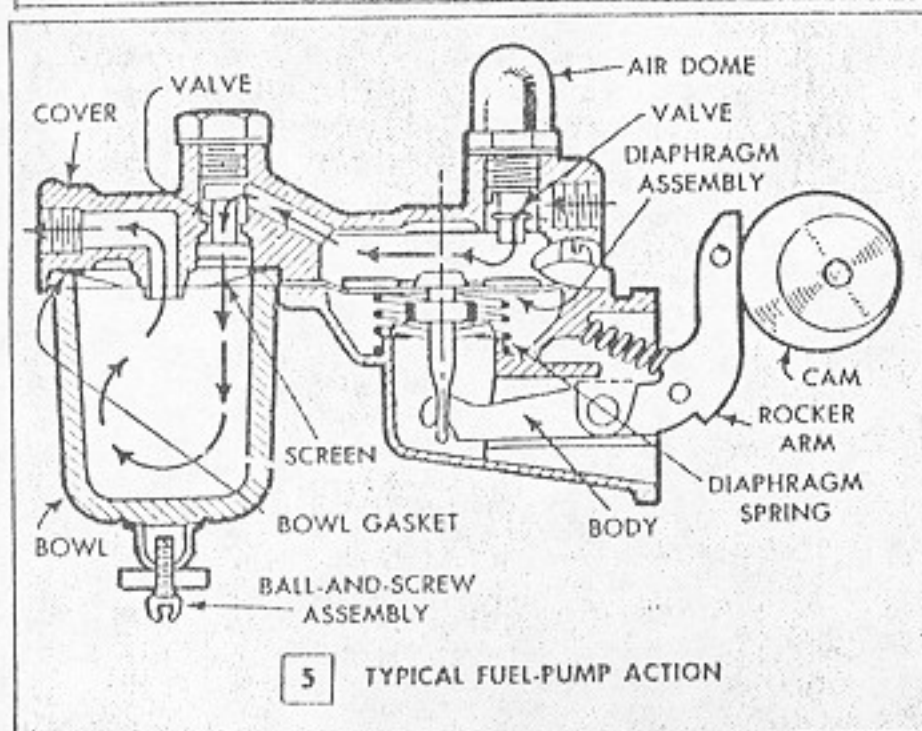
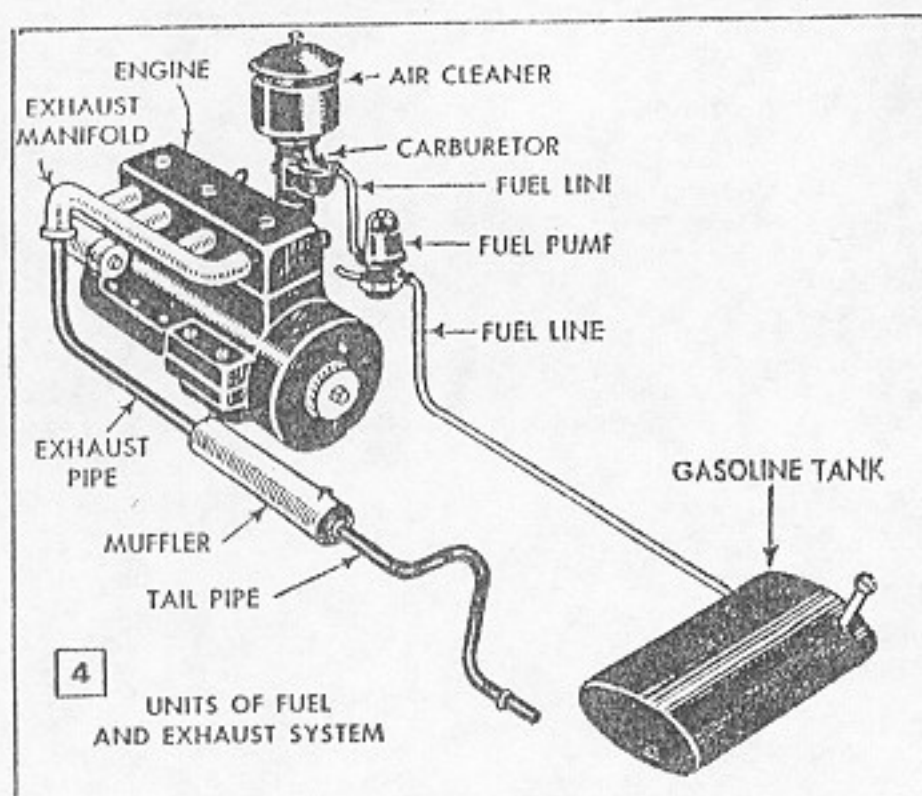
Fig. 4 pictures various related units of the fuel and

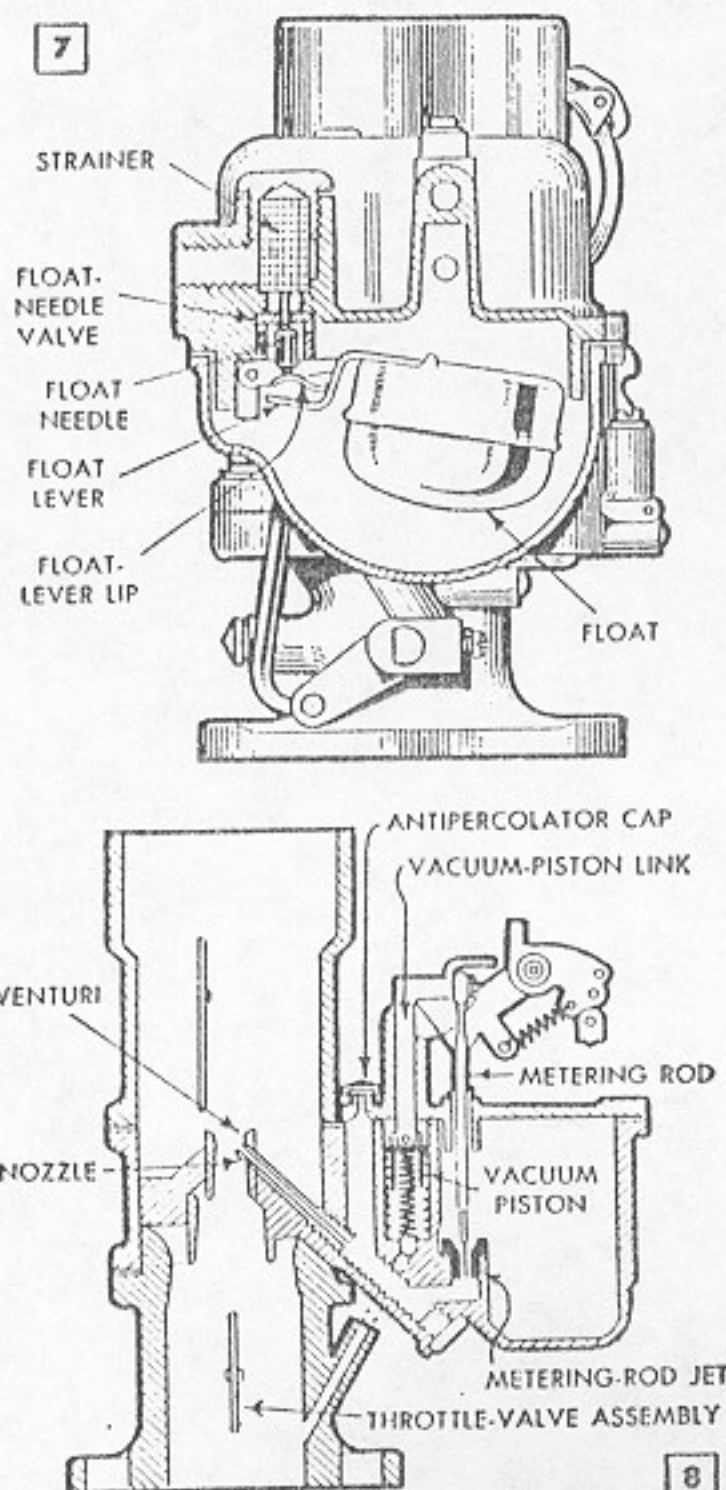
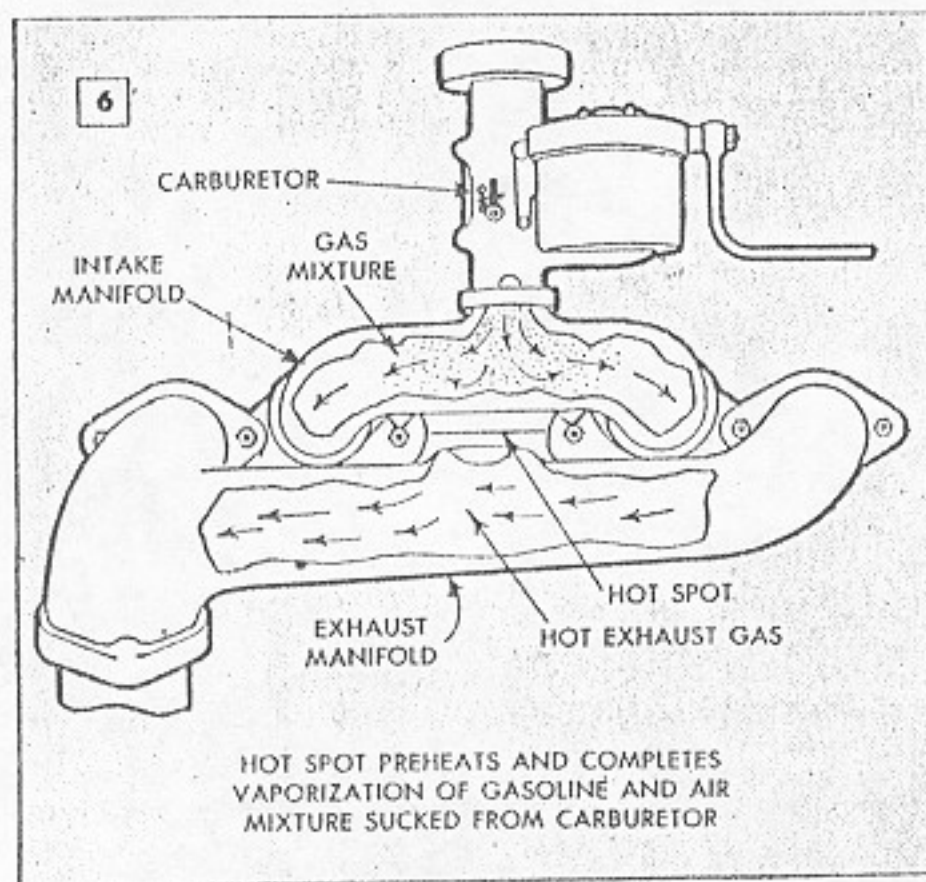
exhaust system. One of the vital parts of the fuel system is the fuel pump and the sectional view, Fig. 5, shows how it works. In operation, the typical fuel pump is quite simple. An actuating arm riding a special cam on the engine camshaft pulls the diaphragm downward against a compression spring. The suction created by the downward movement of the diaphragm draws fuel from the tank through the inlet valve. As the actuating arm reaches the low point on the cam the compression spring forces the diaphragm upward, discharging fuel through the outlet valve and through the sediment bowl to the carburetor. Mechanical failure of the pump is comparatively rare but suspected cases of pump "failure" may be due to other causes, such as water and sediment in the fuel and pinpoint air leaks. Cleaning the sediment bowl regularly and keeping the fuel tank full in cold weather help to rule out the first two causes of trouble. Air leaks along the fuel line usually call for renewal of the faulty parts.

The engine warm-up period has a direct bearing on fuel mileage and it also is dependent on more than a properly operating cooling-system thermostat. In some cars, the fuel charge is passed over a hot spot cast in the intake-exhaust assembly as indicated in Fig. 6. The purpose of the spot is to pre-heat the fuel charge passing to each cylinder and thus assure complete vaporization during the warm-up period. A butterfly valve, which is operated automatically by a thermostat, controls the temperature of the hot spot by directing hot exhaust gases around it. In a cold engine, the valve is closed, but the automatic control slowly opens the valve by stages as the engine reaches operating temperature. It's important to check the action of this valve regularly to make sure that it is in working order. Apply a few drops of light oil to the valve shaft to prevent sticking. Some servicemen say that dry graphite blown into the bearing surfaces with a special applicator gives better results. Of course, it also is essential to keep the cooling system clean and the thermostat adjusted to give correct operating



Above, remove the oil-bath air cleaner, drain out old oil and wash the container and the filter elements thoroughly. Refill with new oil. Below, typical units of fuel and exhaust system





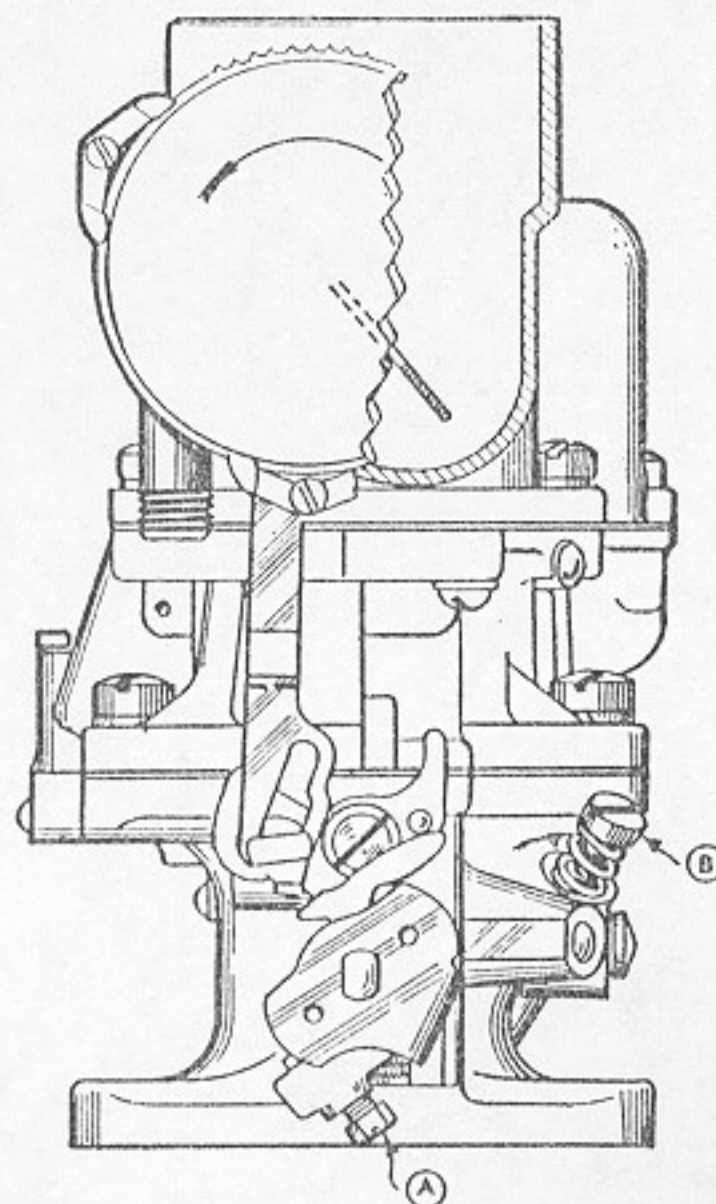
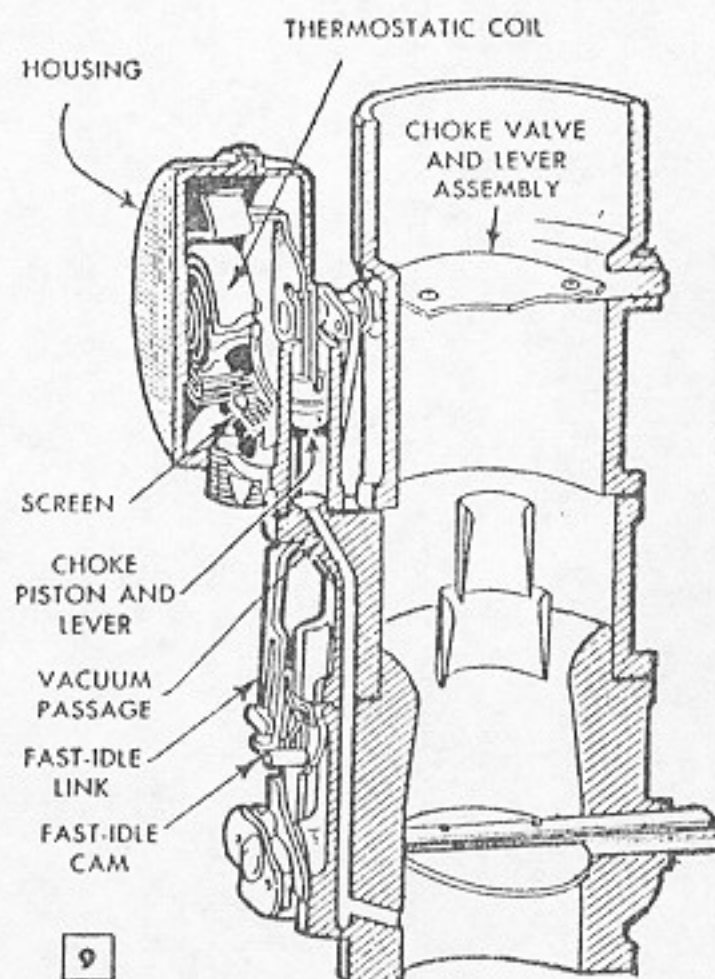
temperature. Should the engine seem sluggish and the ordinary checks turn up no other cause, examine the exhaust pipe, muffler and tail pipe. A broken muffler baffle or a deep dent in either the exhaust or tail pipe can set up sufficient back pressure to cause the engine to overheat. Sticking valves also can result from this defect in the exhaust system.

In any fuel system, the fuel pump and carburetor are designed to work together. The pump maintains a constant level of fuel in the carburetor. The air dome on the pump cushions pump pulsations so that fuel is fed to the carburetor under uniform pressure. One important item on the regular tune-up schedule is inspecting and, if necessary, cleaning the fuel-pump valves, Fig. 5, and also the fuel strainer in the carburetor, Fig. 7. Accumulations of dirt or sediment in any of these parts are certain to cause trouble. The carburetor float, Fig. 7, controls the needle valve through which liquid fuel is admitted to the carburetor bowl as needed. A low float level causes difficult starting and a constant high level results in a major waste of fuel. As the moving parts wear, the float level changes. That's why it is necessary to check the float at regular intervals. The sectional view of a typical carburetor in Fig. 8 shows the location of the metering rod, vacuum piston and the high-speed nozzle, or jet. The idling jet, which supplies fuel to the engine at idling speed, is not shown. All these parts team up to provide the engine with the correct fuel mixture under varying operating conditions. As a routine check for faulty float level, many servicemen remove the air cleaner and inspect the open end of the high-speed jet while the engine is idling. If fuel appears in any quantity at the end of the jet, it usually is safe to assume that the float level is incorrect. It will be necessary to disassemble the carburetor to adjust the float and whenever the unit is disassembled for repair or adjustment it should be thoroughly cleaned and all openings blown out with compressed air before reassembling. These requirements make carburetor servicing a special job which few car owners care to undertake because of the time, skill and special tools required. For this reason most car owners simply exchange the faulty unit for a new or rebuilt carburetor of a type suited to the car. Reputable service shops offer a sound, money-saving deal on this exchange. However, car owners who like to tinker with precise mechanical gadgets will feel sufficiently challenged by the

complexities of the job to do it themselves. For them, there are available carburetor-rebuilding kits for nearly all modern makes. These kits include all parts necessary to do a complete job of rebuilding.

Faulty operation of the modern automatic choke is rarely due to mechanical failure alone, but the unit does require periodic inspection, careful adjustment and occasional cleaning to keep it working properly. Fig. 9 shows a sectional view of a typical automatic-choke mechanism, the notes on the drawing pointing out and identifying the principal parts. Some units are provided with a summer and winter setting and this adjustment should be carried out on schedule. Although the control mechanism is quite simple, it also is very sensitive. Dirt on the bearing surfaces of the parts interferes with their operation. In late-model cars fitted with automatic chokes, the thermostat controls the choke valve and also operates the fast-idle mechanism during the engine warm-up period. At the time of the cold start, the choke valve is closed and the fast-idle mechanism holds the throttle partly open. As the engine warms to operating temperature the choke valve opens by stages, achieving the full-open position as the engine reaches normal operating temperature. Simultaneously the choke mechanism closes the partly opened throttle and the engine slows to normal idling speed. Parts remain in this position as long as the engine is hot. When the engine cools, the thermostat returns the parts to the cold-start position. Action of the thermostat is controlled by heat from the engine exhaust manifold which is conducted to the thermostat housing through a small tube. Heat from the manifold passes through a screen located in the housing, as in the sectional view. Clogging of this screen is the principal source of trouble with the unit. Periodic inspection and cleaning or renewal of the screen practically rules out the possibility of defective operation.

Late-model cars having automatic transmissions require a precise adjustment of idling speed and the fuel mixture. Many service shops consider the idling adjustment so important to the satisfactory operation of the car that they use a tachometer to check engine speed when making the adjustment. The idling adjustment on nearly all carburetors is made by means of the adjusting screw shown at A in Fig. 10. Turning the screw in (clockwise) causes the engine to idle faster. The idling mixture is controlled by the screw B, Fig. 10. Turning the screw in "leans" the fuel mixture. Always have the engine at operating temperature before making these adjustments to the carburetor.



10 CARBURETOR ADJUSTMENTS

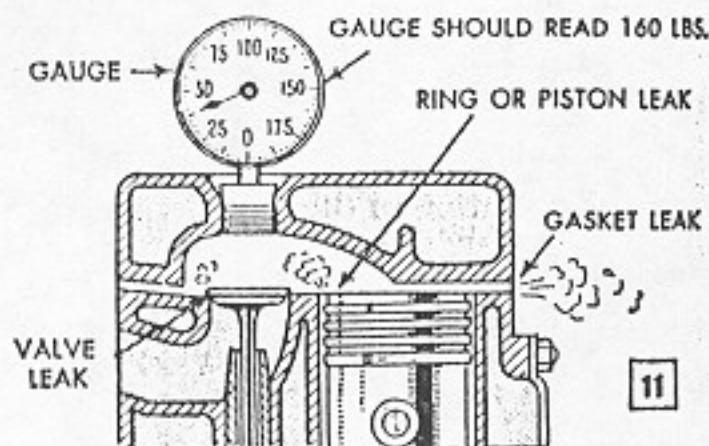


Driving at moderately high speeds for an hour or so will "tune up" an engine that is in good condition

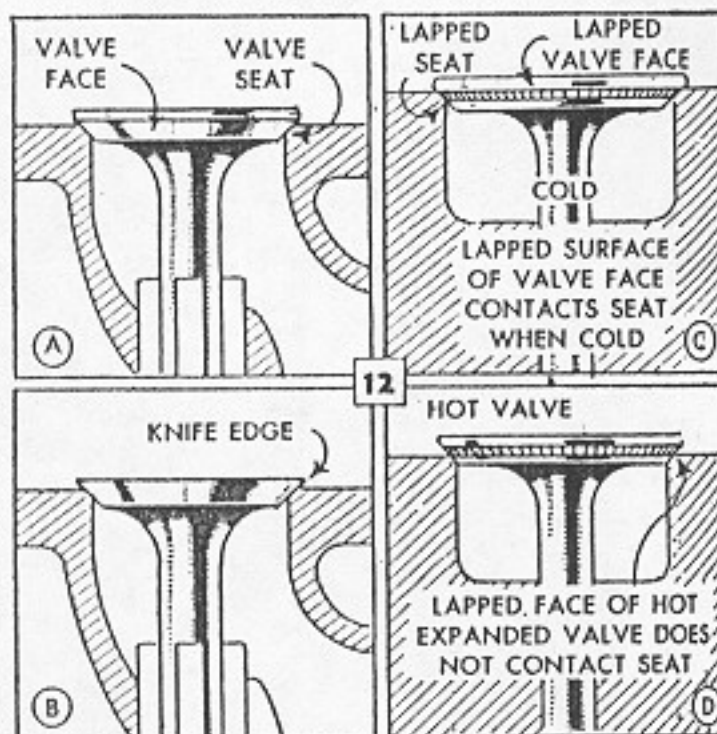
The carburetor speed-and-mixture adjustment can be made only when the engine is thoroughly warm and running at about 500 revolutions a minute. Occasionally the speed may change when the mixture is improved. In this event, the speed should be reset. If turning the idle screw in doesn't stall the engine, there is trouble in the carburetor. Start the investigation at the idle orifice tube and continue to the idle air bleed. On an old car replacement of a worn throttle-valve shaft and throttle body in the carburetor usually corrects an imperfect fuel-air mixture.

Faulty compression: Although auto servicemen usually rate the fuel system first in seasonal tune-up checks, the engine itself also comes in for a thorough going over. To a greater extent than car owners generally realize, the loss of engine smoothness and operating efficiency is due to slowly accumulating deposits of hard carbon, gum and crankcase sludge. Short runs in cold weather, long trips at slow speeds and neglect of oil changes and general servicing of the engine contribute to fouling of the crankcase, upper cylinders, pistons and rings. The carbon and gum deposits not only adhere to these vital parts but circulate throughout the lubricating system and cause rapid wear. Regularly changing the oil-filter cartridge may help, but this precaution alone is not sufficient to correct other causes of engine inefficiency which are due to bad driving practices.

Lately the use of solvents has become so important in connection with general engine tune-up that many mechanics use these chemicals regularly in tune-up jobs

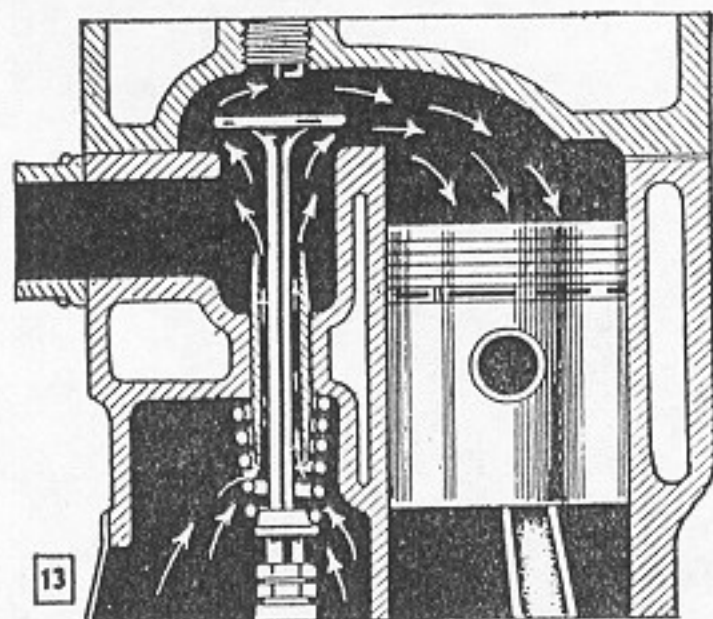


One of the best quick checks of engine condition can be made with a compression gauge



on engines which are rated in good mechanical condition. Solvents for sludge and carbon are used in three ways: added in measured amounts to the fuel, introduced directly into the air inlet to the carburetor and combined with the crankcase oil. It's a general practice, after adding the solvent, to operate the engine for at least 30 minutes at fast idle. Following this desludging, or "limbering," treatment, the crankcase is drained and flushed, the oil-filter cartridge is changed and the crankcase is refilled with new oil.

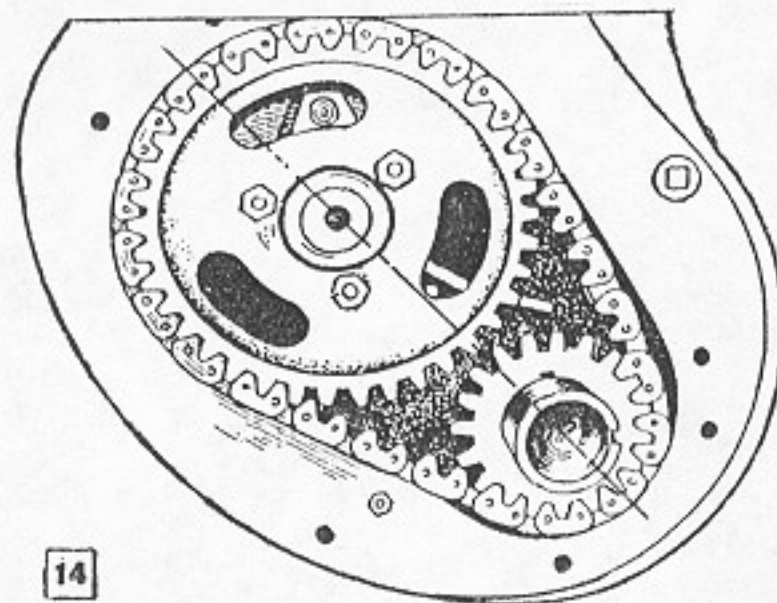
One of the best quick checks of general engine mechanical condition is made with a compression gauge, Fig. 11. A variation of more than 10 lbs. pressure between cylinders indicates the presence of mechanical faults which need further investigation. The test always should be made with the engine at operating temperature and the throttle and choke in the wide-open position. Two faults commonly turned up by a compression check are bad rings and valves. To determine whether the valves or rings are at fault without removing the cylinder head, unscrew the spark plug and place about a tablespoonful of heavy oil on



Oil leaks through the intake valves are due to worn guides. Replacement of guides usually is necessary

top of the piston to form a temporary compression seal. Replace the gauge and repeat the test. If the gauge comes up to normal, it is safe to assume that the rings are defective. There also is the possibility that either the piston or cylinder wall is at fault. If no change in the reading results from the second test, then the trouble probably is due to faulty valves. Sometimes a head-gasket leak is the cause of a low reading in one cylinder but this is comparatively rare. If the result of the tests indicates valve trouble, an experienced mechanic will listen carefully at the carburetor air intake and tell you in a moment which valve is leaking in the faulty cylinder. How does he do it? It's simple, when you know what to listen for. A leaking intake valve makes a sharp, distinct hissing sound, but a leak at the exhaust valve cannot be heard because the leakage is into the exhaust manifold.

If the engine has a history of poor performance, then the compression check is likely to be only the start of the job. On older cars, hand grinding and lapping valves and valve seats is a common procedure, but on later-model cars with high-com-

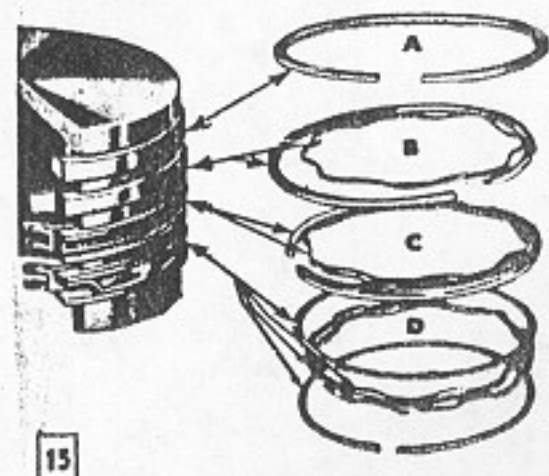


Check the timing chain, or gears, for looseness due to wear. This can cause late timing of the valves

pression engines the valves and valve seats must be reconditioned with special equipment. It is possible, of course, to form a gas-tight joint between the valve and its seat by hand lapping. Of necessity this must be done when the parts are cold, detail C, Fig. 12. When the parts expand as a result of heat, the lapped surfaces no longer make contact, D, Fig. 12. When the valve and seat are ground at the same angle on equipment made for this purpose, the tight-fitting job shown in detail A, Fig. 12, is the result. Never machine or grind old valves to a knife edge as in detail B. When the valve gets hot, the edge may become incandescent and cause what is known as pre-ignition.

Before opening an engine, let it idle for at least 10 minutes, as the high vacuum resulting from idling will tend to draw oil up around loose pistons and worn valve guides. As soon as the cylinder head has been removed, look for oil on the piston heads and on the undersides of the intake valves. If there is oil on the valves, it indicates that oil from the crankcase is being drawn up through the valve chamber and into the cylinder as in Fig. 13. As a rule, this con-

In any new ring job, the cylinder bore should be checked with a dial gauge after the piston has been removed

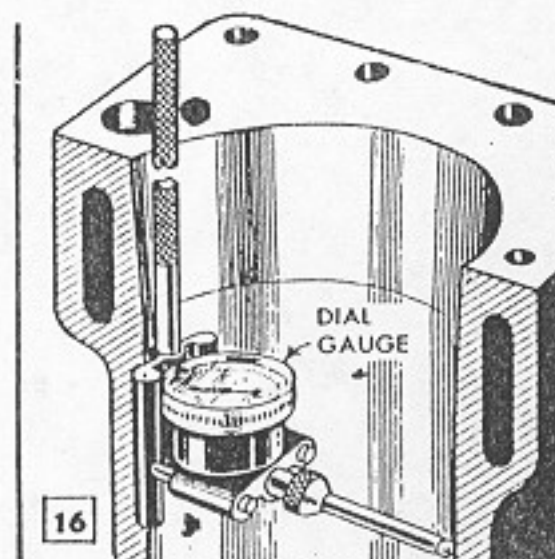


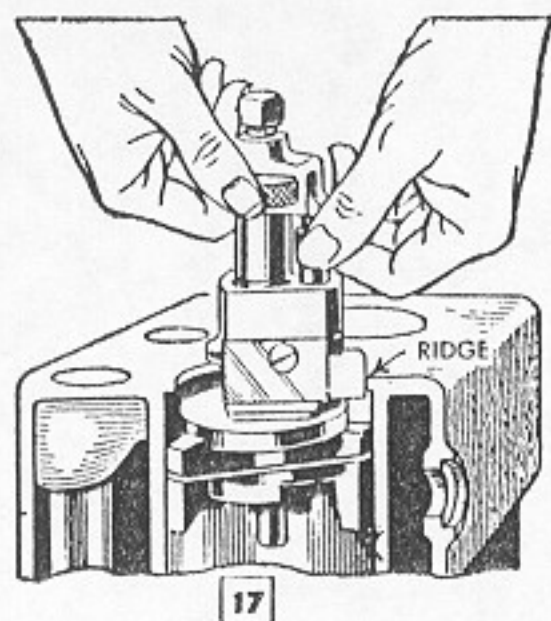
A—TOP COMPRESSION RING

B—SECOND COMPRESSION RING WITH EXPANDER

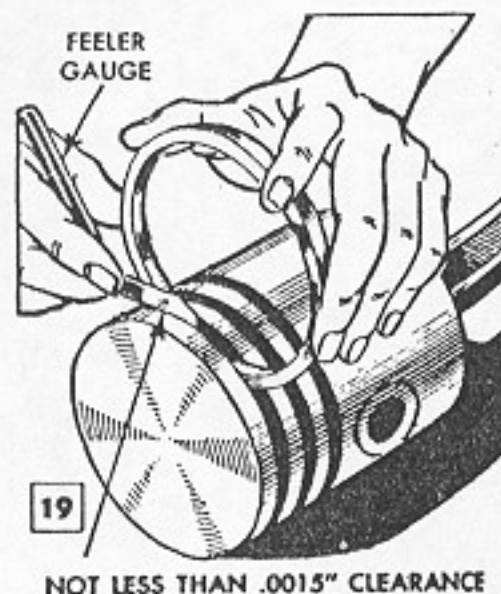
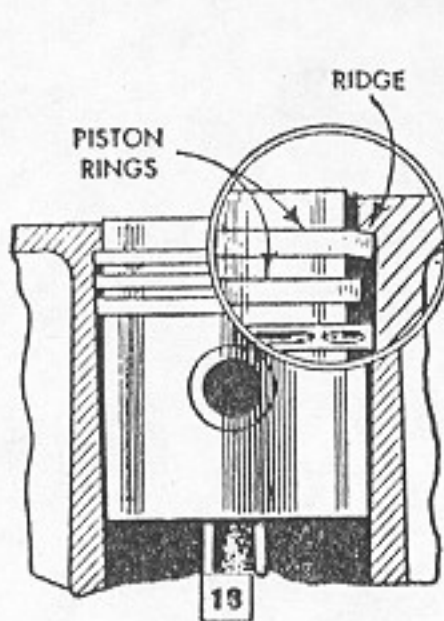
C—CHANNELED UPPER OIL-CONTROL RING WITH EXPANDER

D—LOWER OIL-CONTROL RING FOUR-SECTION TYPE





Before removing a piston, cut away the ridge at the top of the cylinder bore with a special reamer



A new ring should roll freely all the way around in the ring groove as, otherwise, the ring may stick

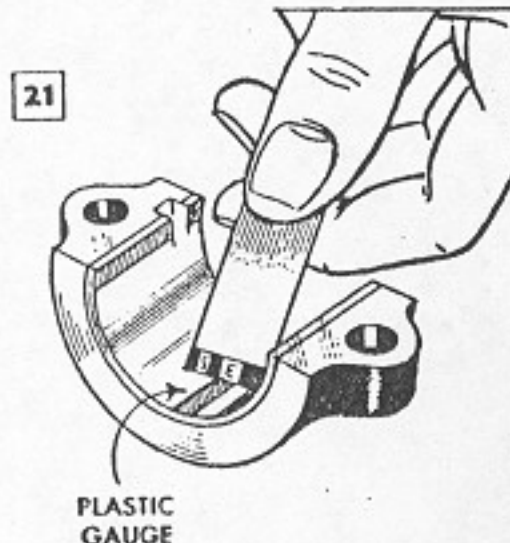
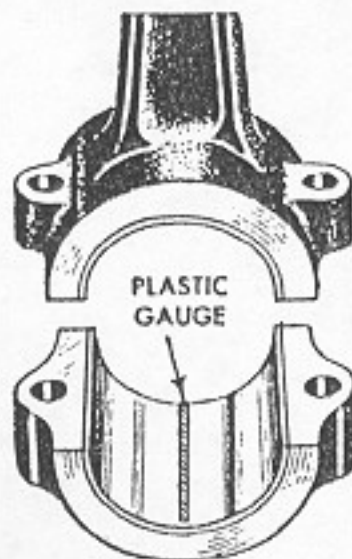
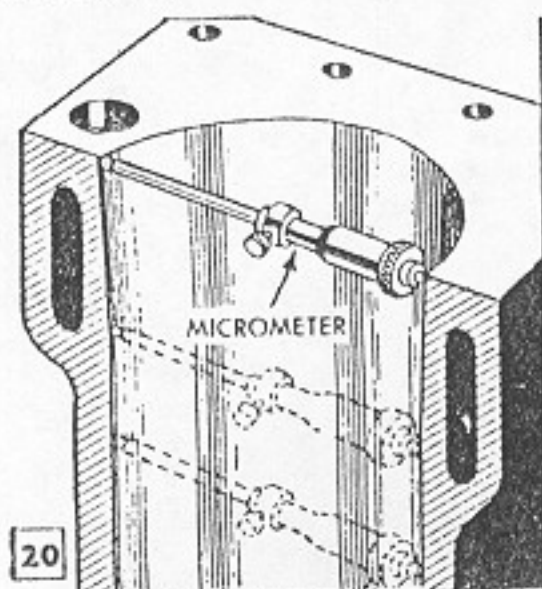
dition calls for replacement either of the valve or the guide, or both. While the engine is open, check the timing chain for looseness resulting from wear. Slack in the chain or wear in the camshaft gears has the effect of late valve timing, Fig. 14. If the intake valves open after the pistons have passed the top dead center, oil will be drawn through loose valve guides into the cylinders. Of course, this condition will be encountered more often in engines of the L-head type.

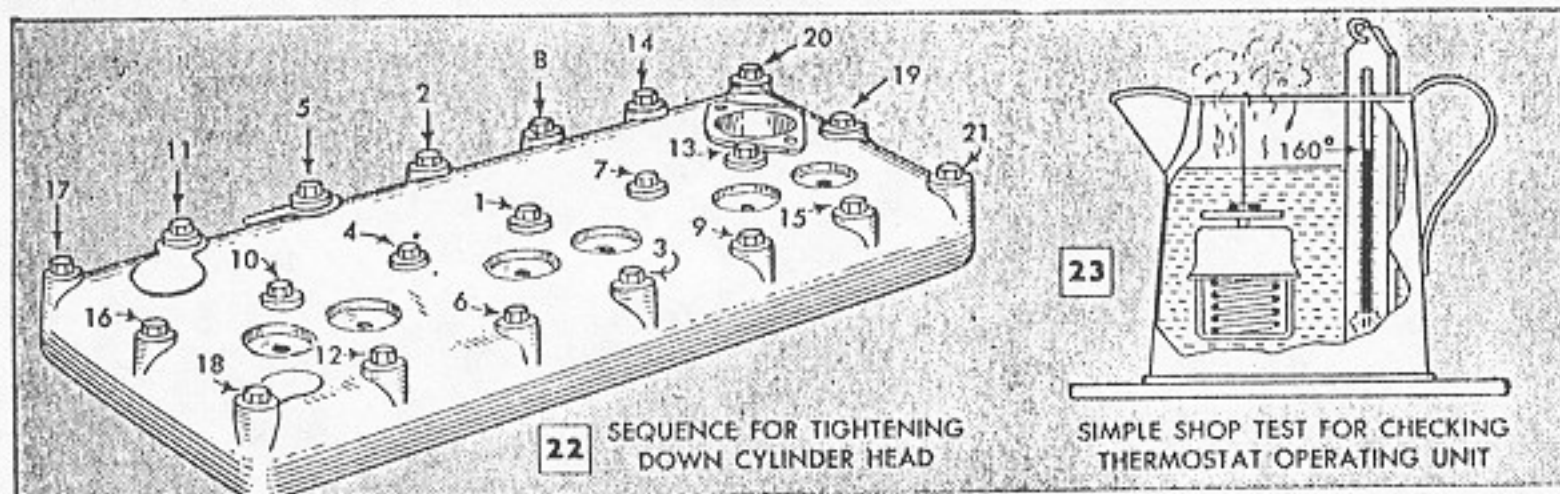
Before pulling the pistons on any engine which has been subjected to considerable wear, always remove the ridge, or overhang, at the top of the bore with the special reamer shown in Fig. 17. Otherwise, you will have difficulty removing the pistons, Fig. 18. After the pistons have been removed, careful mechanics mike the bores as in Fig. 20, or use a dial gauge as in Fig. 16, and jot down the readings. If these readings show that a rebore job is necessary, it's a general recommendation that the cylinder walls be honed both parallel and round within .0005 in. When installing oversize pistons be sure to follow the manufactur-

er's recommendations for clearance per inch of diameter. This is important and usually the instructions are specific.

When installing piston rings, check each individual ring for up-and-down clearance in its own groove, Figs. 15 and 19. The ring grooves are always cleaned and rigidly inspected to make sure that each ring will roll freely all the way around the groove, Fig. 19. End gap is just as important as the up-and-down clearance. A general recommendation ranges from .006 to .010 in., depending on the type of ring and the diameter of the cylinder bore. In bores larger than 3 in. the recommendations range from .010 to .014 in. In any case, a ring job cannot be considered complete until the connecting-rod bearings have been carefully inspected for looseness. Loose crankpin bearings can completely upset the function of the oil-control rings by throwing an excess of oil on the cylinder walls. Mechanics check bearing clearances with a simple plastic gauge, Fig. 21. This is laid on the bearing cap as in the left-hand detail. The cap is fitted in place, tightened, and then removed. Because of the precise diameter

Plastic gauge makes it easy to check crankpin-bearing clearance. If clearance is too great, oil pumping results

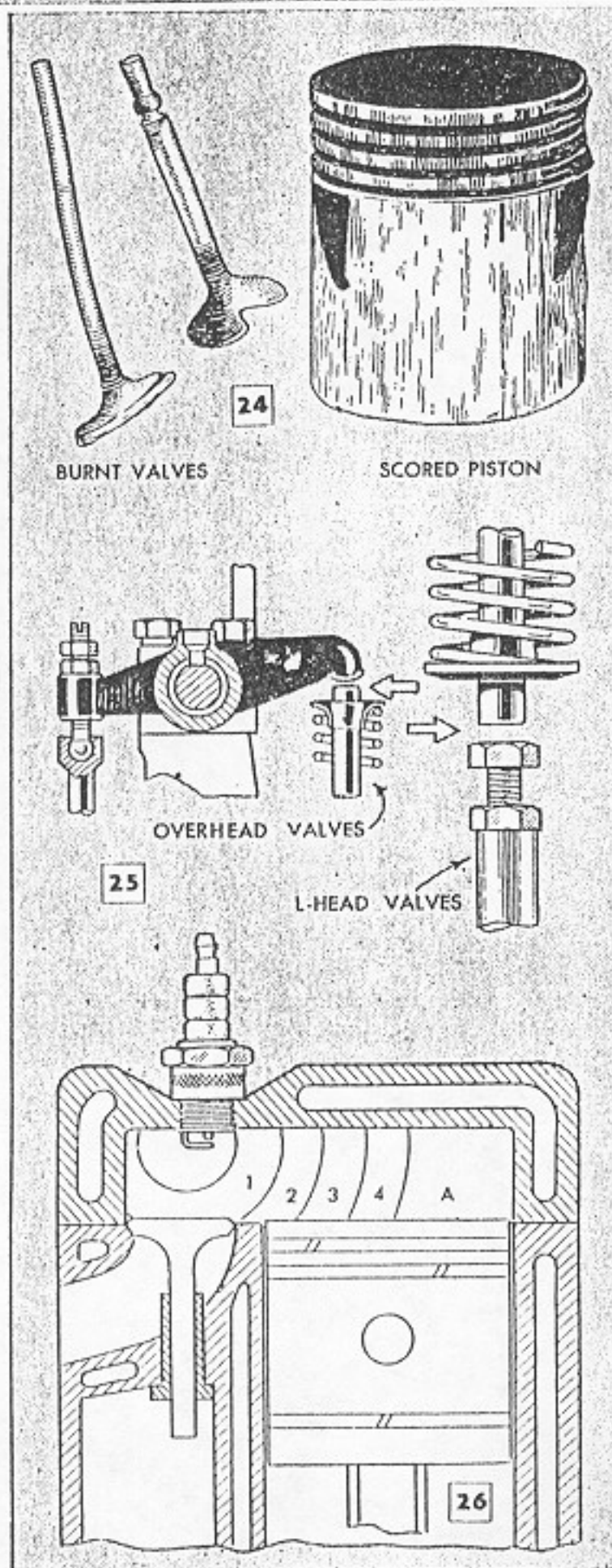


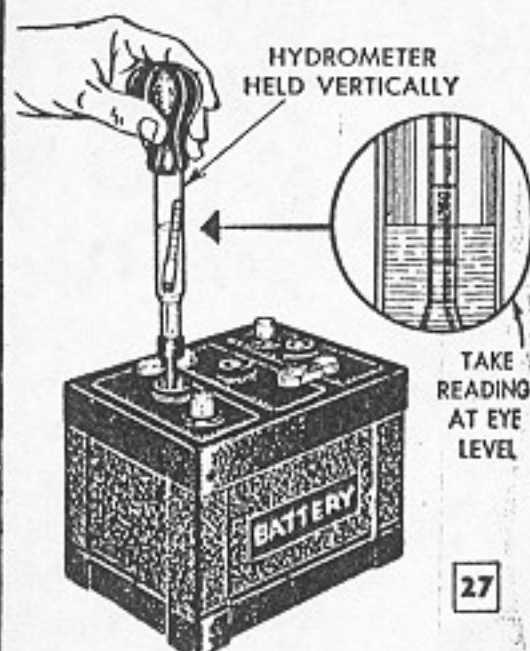


of the plastic gauge, the amount it is squeezed, or flattened, can be read in thousandths of an inch of bearing clearance by means of a printed chart which is held against the flattened plastic at the widest point, right-hand detail Fig. 21.

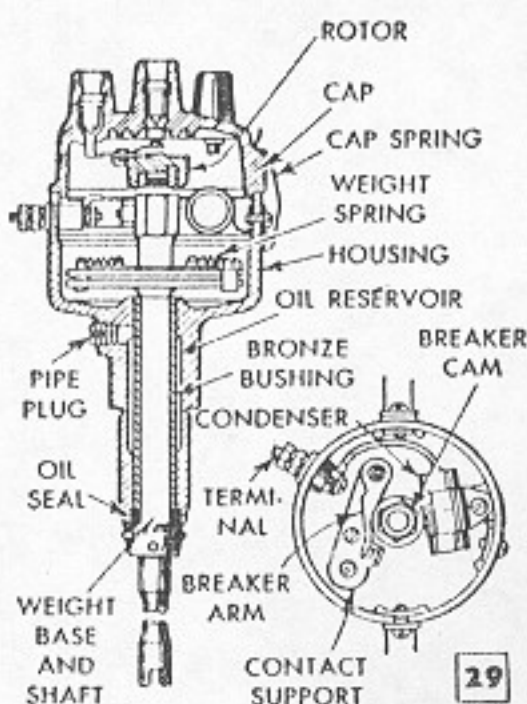
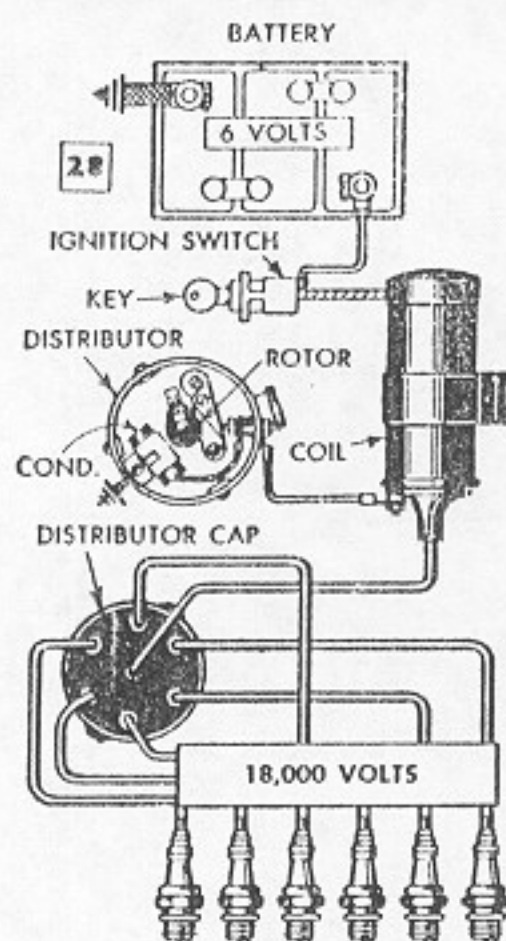
In any major overhaul job where the engine has been opened, always flush out the block and the cylinder head. Sediment may collect and clog water passages causing burned valves and scored pistons, Fig. 24. Check the thermostat, Fig. 23, before replacing it. If the thermostat is functioning properly, it will open in the 160-deg. water bath. A high-temperature thermostat used with permanent antifreeze solutions will begin to open at 175 degrees. Use a new gasket under the cylinder head. The tricky part of reassembling an engine is tightening down the cylinder head. It is of the utmost importance that the tightening sequence be followed precisely as instructed by the manufacturer of the car. The sequence given in Fig. 22 is only general; it will not apply to all makes of cars with L-head engines. However, the sequence in nearly all recommendations begins with the center bolt, No. 1 in Fig. 22, and progresses from the center to the ends of the head. It's best to use a torque wrench and tighten the bolts by stages. Instructions for the final tightening vary, of course, but a common recommendation is to tighten all bolts uniformly to a 50-ft.-lb. tension. After tightening the head, check the valve clearance as illustrated in Fig. 25.

Detonation, or ping, as it is called, is a secondary ignition, or explosion, that follows normal combustion of the fuel charge. With the piston at top dead center, Fig. 26, or a little below it, ignition takes place progressively through areas 2 to 4 inclusive. Unburned fuel in area A explodes violently as a result of heat and pressure created by the normal ignition. In addition to low-grade fuels, other causes of pinging are a lean mixture, spark too far advanced and an engine running above normal temperature. If an engine gives trouble from pinging, the causes should be corrected. The ignition system should be checked.





JUST ENOUGH ELECTROLYTE IS DRAWN IN TUBE TO PERMIT FLOAT TO CLEAR BOTTOM



Ignition system: Good ignition demands three things. First, a good spark must be created. Second, this spark must be fired into the combustion chamber. Third, arrival of the spark at exactly the right time is necessary for maximum engine power, speed, smoothness and economy. So while ignition is a big subject there are little details that make the difference between a car that merely runs and one that runs well. One of these details is the secondary circuit that includes the coil in its function. The strength of the spark will be influenced by the amount of current flowing from the coil. No part of the battery current ever gets to the spark plugs. Yet a fully charged battery may give us a good spark, and a low battery a poor spark.

Did you know that 6-volt current from the battery in your car is stepped up as high as 18,000 volts at the plugs, and that in an 8-cylinder car the electrical system steps up the current 12,000 times for every mile you travel? When you cruise at 45 miles per hour, 150 high-voltage sparks are formed at the spark-plug electrodes each second. This allows $\frac{1}{150}$ second for distributor points to close and open for current to build up in the coil and be delivered to the plugs.

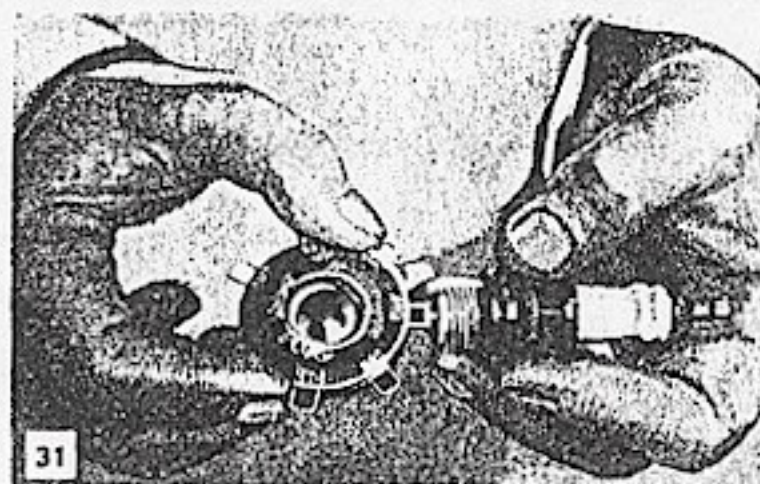
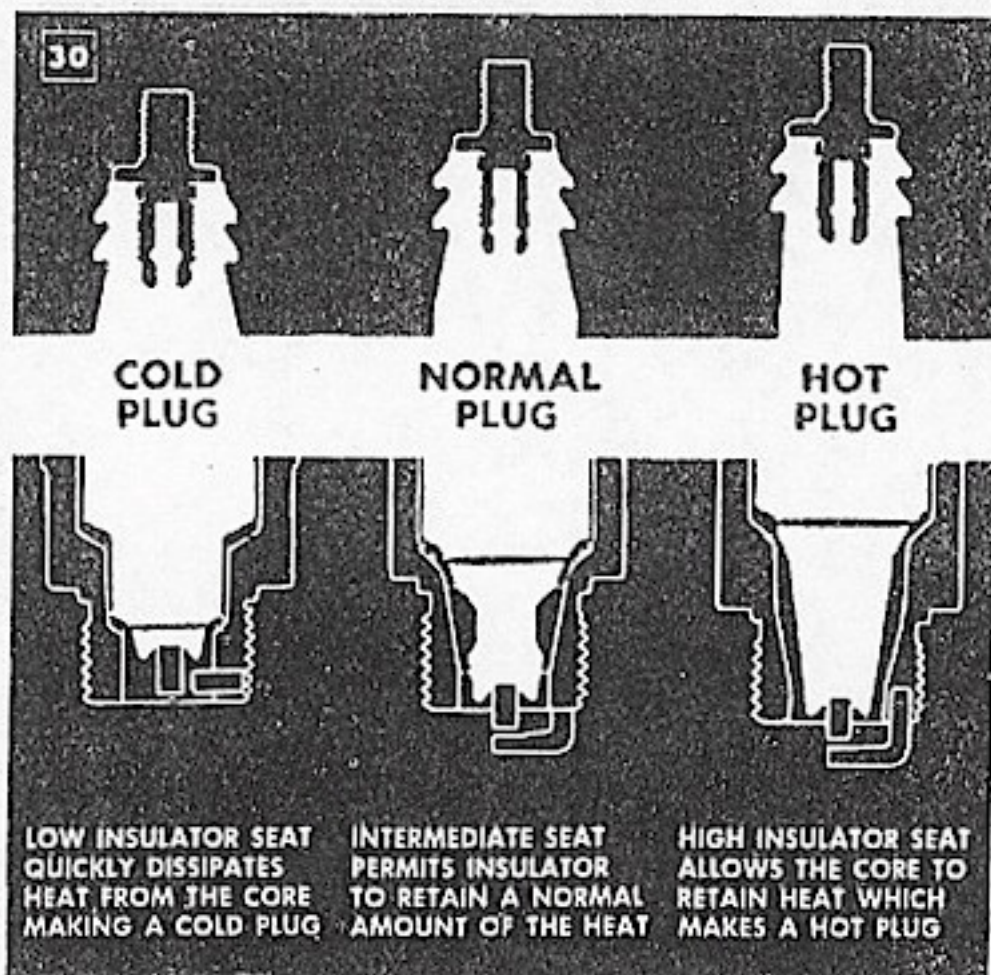
Such a mechanism, Figs. 28 and 29, requires periodic attention at least every 5000 miles. There are several simple checks that any car owner can make in the home garage and thereby head off serious trouble. By thoroughly familiarizing himself with the parts of the ignition system and how they work, he can assure himself a good deal when buying the essential service. It pays to own a battery hydrometer and use it regularly, Fig. 27. The best battery performance is had when the state of charge, as indicated by the hydrometer, ranges between 1.270 and 1.300 on the hydrometer scale. A variation of 20 to 25 points in the readings between the cells indicates that trouble is developing which will require an immediate investigation to determine the cause. Another simple battery service that the motorist can perform himself is keeping the battery and terminals clean. Wash the battery case and holder occasionally with a soda-water solution to neutralize acid. Rinse the parts immediately with clear water and dry them. See that the terminals are clean and the cable clamps are tight. Then coat all the parts with an anticorrosion compound

suitable for this purpose.

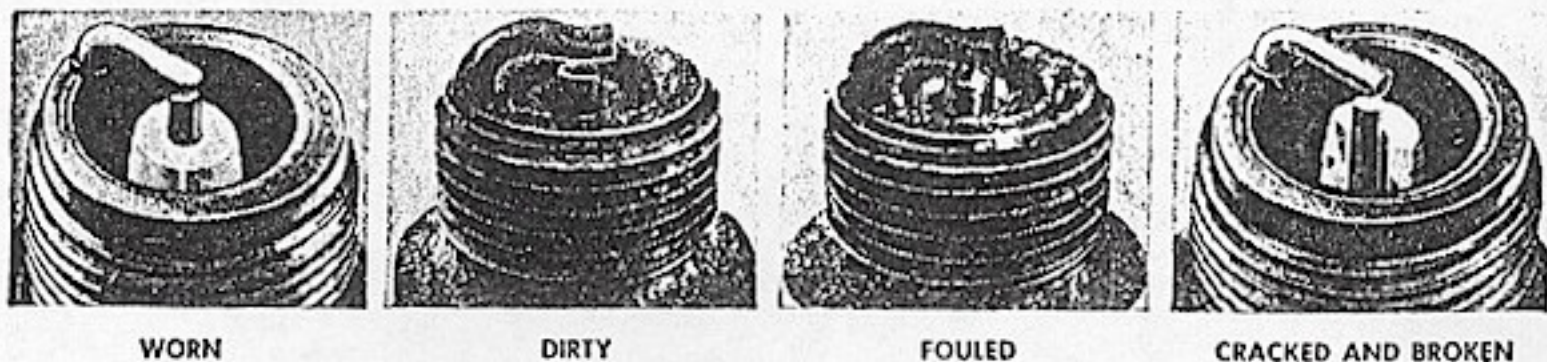
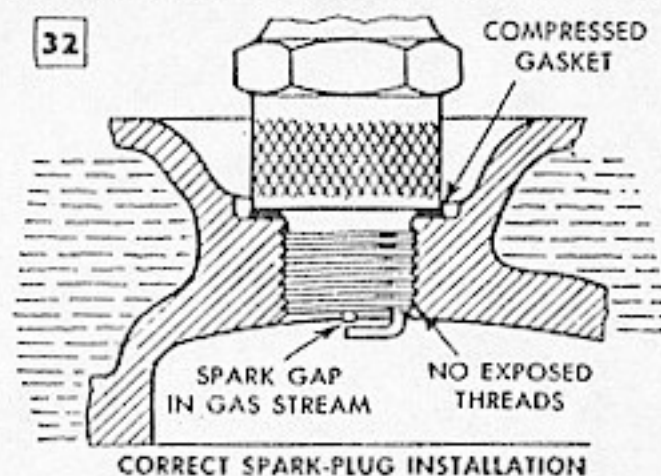
It's good economy to replace spark plugs every 10,000 miles. The four photos at the bottom of the page show the usual history of a worn plug and also why plugs should be replaced at regular intervals. Besides going through regular stages of deterioration, which are readily apparent on careful examination, the plugs also are good indicators of the general condition of the engine and the ignition system. For example, the fouled plug indicates to a practiced eye one of two possibilities: Either the cylinder from which the plug was removed is in rather bad mechanical condition, or that some defect in the ignition system is causing this particular plug to foul. When a plug misses, it does not burn off the oil vapors which come in contact with it in the normal cylinder. Hard carbon deposits quickly build up to the point where the plug no longer fires, even intermittently. If this condition is neglected, even for a comparatively short time, a scored cylinder will result.

The center electrode of the plug is the hottest point in the engine. Note the difference in the shape of the porcelain insulator in the cold, normal and hot plugs detailed in Fig. 30. Most passenger-car engines are designed for the normal plug. The cold and hot plugs are designed for use in engines which must operate under extreme conditions. Cold plugs give the best service in cars which are driven at high speeds on long, steady runs in warm weather. Hot plugs are best where the service requires frequent starts and long periods of idling.

When cleaning and adjusting the plugs, use the simple gap gauge shown in Fig. 31. Always install new gaskets when replacing plugs which have been removed from the engine for servicing. Slight gas leakage at the gasket will cause the plug to run hot and may shorten its useful life by as much as half. When replacing the plugs, wrench torque should be just sufficient to compress



Above, always use a gap gauge in setting spark-plug electrodes. Below, tighten plug to compress the gasket

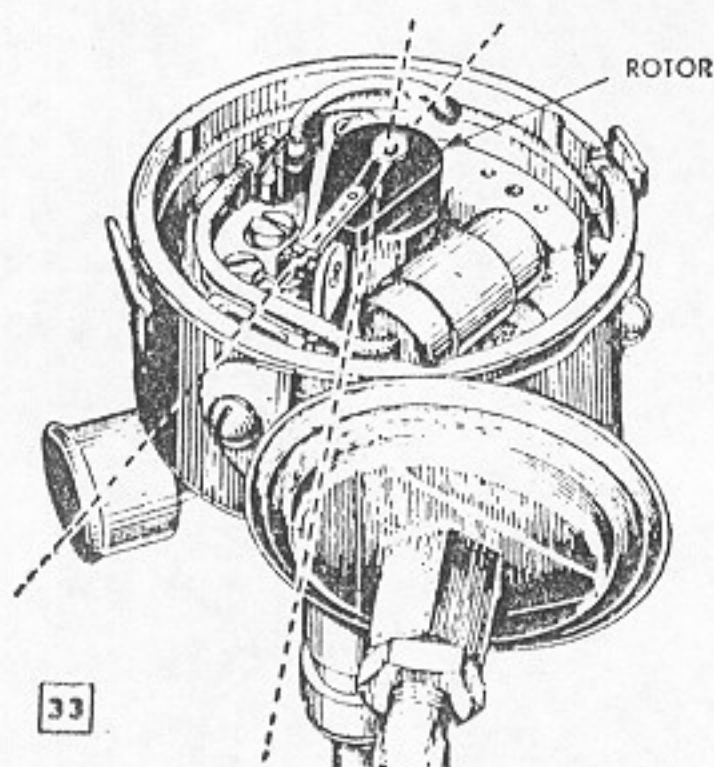


WORN

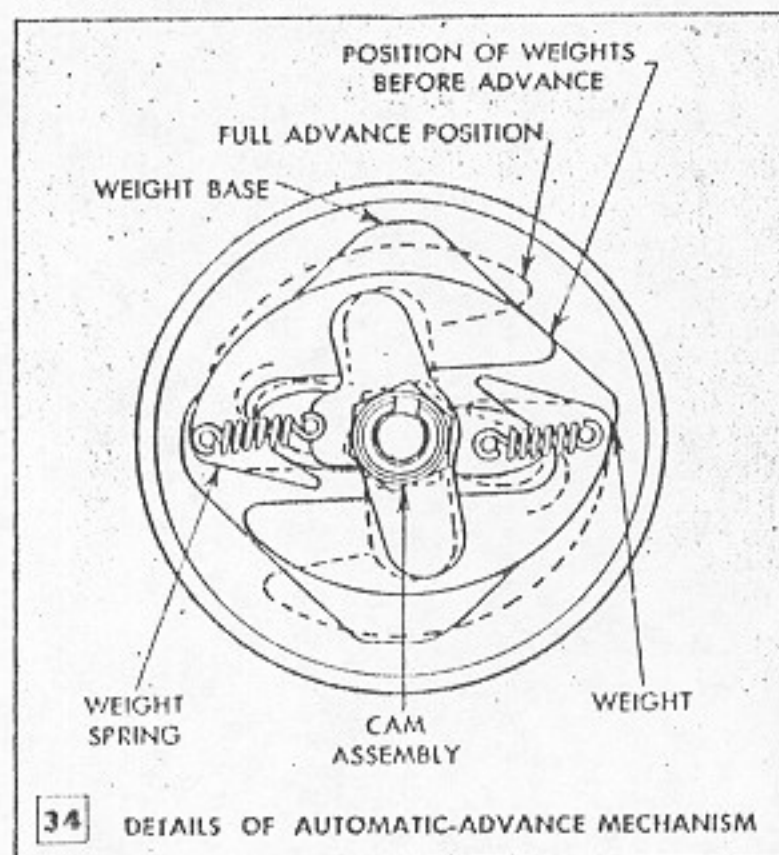
DIRTY

FOULED

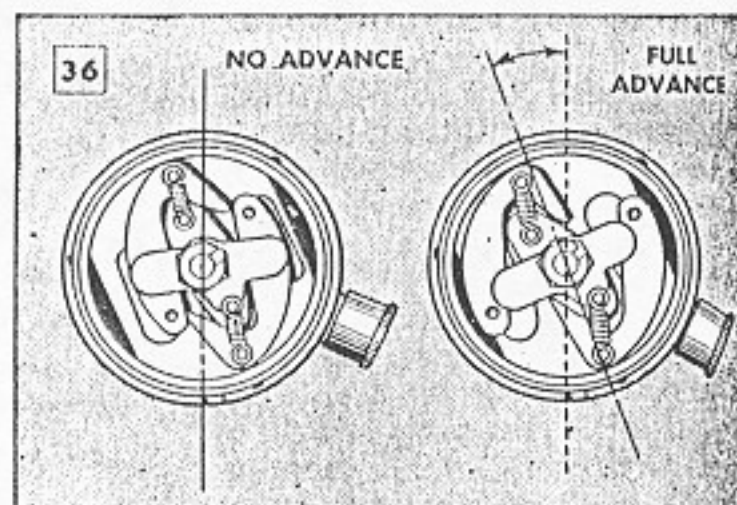
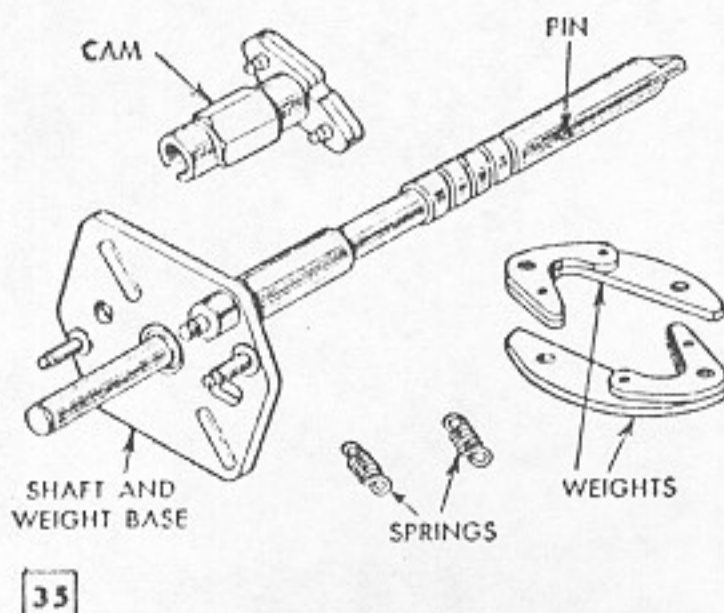
CRACKED AND BROKEN



Above, move distributor rotor to check spark advance. Below, forces acting on the weights pull them outward



DETAILS OF AUTOMATIC-ADVANCE MECHANISM



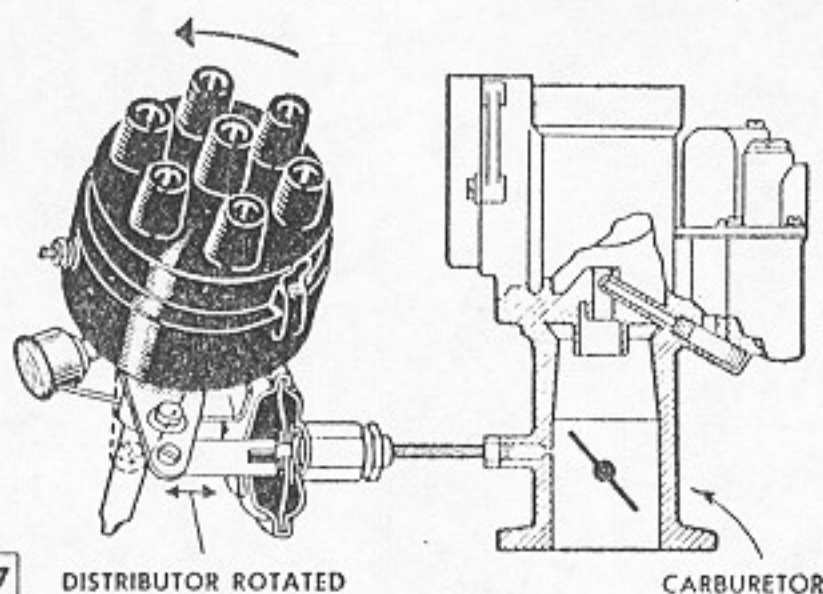
the gasket, Fig. 32. Manufacturers furnish data sheets giving the correct wrench torque for each type and size of plug.

Figs. 33 to 39, inclusive, detail the various parts which make up the distributor and spark-advance mechanism. Whenever the engine speed changes, parts of the automatic spark-advance mechanism move as in Figs. 34 and 36, changing the relative positions of the cam and distributor shaft as indicated by dotted lines. Because of this movement, lubrication is necessary to assure uniform operation of the spark-advance unit. Lift off the rotor, Fig. 33, to expose the felt wick in the hollow end of the cam, Fig. 35. Place a drop or two of light oil on the felt. In distributors having an oil reservoir, or a grease cup, Fig. 33, add light oil, or grease, at intervals of 20,000 miles. Don't fail to check the supply of lubricant whenever the distributor is overhauled. Always avoid over-oiling or greasing, as any excess may find its way into the distributor housing and cause arcing and burning of the parts. A quick and fairly reliable check of the automatic-advance mechanism can be made by removing the distributor cap, gripping the rotor lightly between the thumb and index finger and turning it a few degrees in the normal direction of rotation as in Fig. 33. When released it should snap back to its original position. As detailed in Figs. 34, 35 and 36, the automatic-advance unit consists basically of two weights, Fig. 35, the outward movement of which is resisted by two accurately calibrated coil springs. As the engine speed increases, centrifugal forces acting on the weights pull them outward against the resistance of the springs to the full-advance position shown in Fig. 36. As the engine slows to idling speed, or when it is stopped, the parts automatically return to the no-advance position. In modern cars kept in good condition by periodic servicing, this unit rarely gives trouble. It should never be removed or tampered with unless the nature of the trouble necessitates removal.

The vacuum-advance mechanism works in correlation with the automatic advance

and controls spark position in accordance with engine load. Fig. 37 shows how it works. Movement of the diaphragm is controlled by manifold vacuum. The diaphragm is connected to the distributor by means of a short link. Movement of the diaphragm rotates the distributor, changing the relative positions of the breaker arm and cam. Checking spark advance according to vacuum and speed is a job for experienced servicemen with specialized equipment.

The two details in Fig. 38 bring up a point often overlooked in distributor servicing. As a rule the defect shows up more frequently in heavy-duty units, but it can occur in any distributor in which the wrong condenser is used. If the electrical system has a negative ground, a deep pit in the moving-arm contact point indicates the use of an over-capacity condenser, but if the pit is in the grounded point, or negative side, as in the right-hand detail, the condenser capacity is inadequate. If this condition is noted when servicing the distributor, the parts should be replaced and the condenser checked and renewed. Otherwise, smoothing the breaker points on an oilstone will be sufficient to remove shallow pits. When installing after smoothing on the oilstone, make sure that the points make the maximum contact. If one or both points have been distorted in the smoothing process so that only the edges make partial contact, they will quickly burn and pit. When the points are removed for any reason, it is worth while to check the tension of the breaker spring. Although there are various methods of doing this, a sufficiently accurate check can be made with a simple spring scale reading in ounces, Fig. 39. The tension, in ounces, should agree with the specification in the instruction book accompanying the car. If the tension is less, the spring should be renewed. Too little tension will permit the points to rebound, especially at higher speeds, and cause irregular ignition. Too much spring tension causes the fiber block on the moving arm to wear rapidly. Also, when servicing the distributor, be sure to check the distance the points open. The recommended distances vary considerably, so be sure that the opening checks exactly with that specified for the car. If it does not, then the points must either be adjusted to the correct opening, or replaced if they are badly worn. Finally, after all routine distributor checks have been made, rub a very small quantity of grease on the breaker cam and place a drop of light oil on the breaker spring to prevent rust. Never more

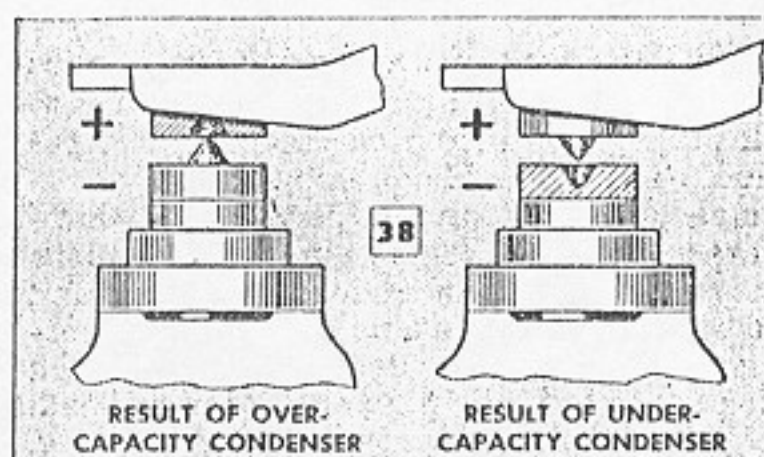


37

DISTRIBUTOR ROTATED

CARBURETOR

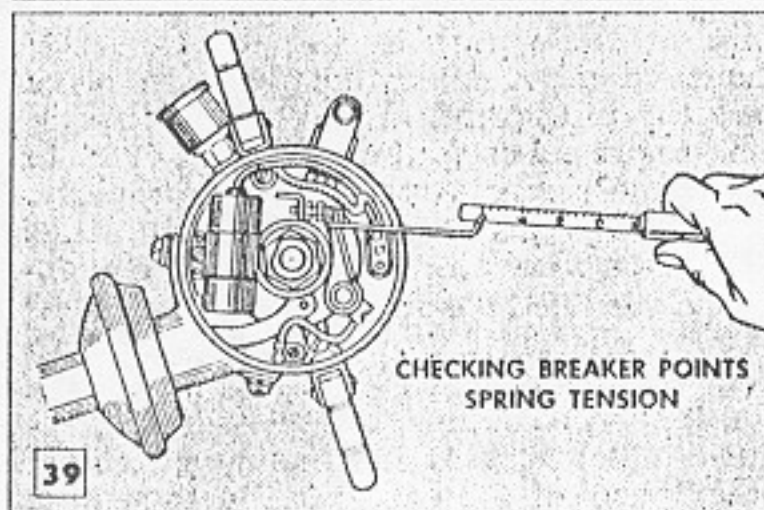
Above, vacuum advance rotates the distributor. Below, the details show results of using over and under-capacity condensers



38

RESULT OF OVER-CAPACITY CONDENSER

RESULT OF UNDER-CAPACITY CONDENSER



39

CHECKING BREAKER POINTS
SPRING TENSION

than a drop of oil is permissible for it should be remembered that any excess of oil or grease in the distributor is likely to cause trouble. Some experienced servicemen do not recommend it at all. However, if carefully applied, the minimum quantities of oil and grease on the parts specified will prevent rust and undue wear. Always wipe the inside and outside of the distributor cap and be sure it is locked firmly in position when replaced. Check the contact of the high-tension cables to the plugs and to the coil and check the cables to make sure there are no breaks in the insulation. If the metal terminals at the ends of the cables are cracked or otherwise damaged it will pay to renew the cables to prevent a short should the cable jar against the frame.

CAR'S ELECTRICAL SYSTEM

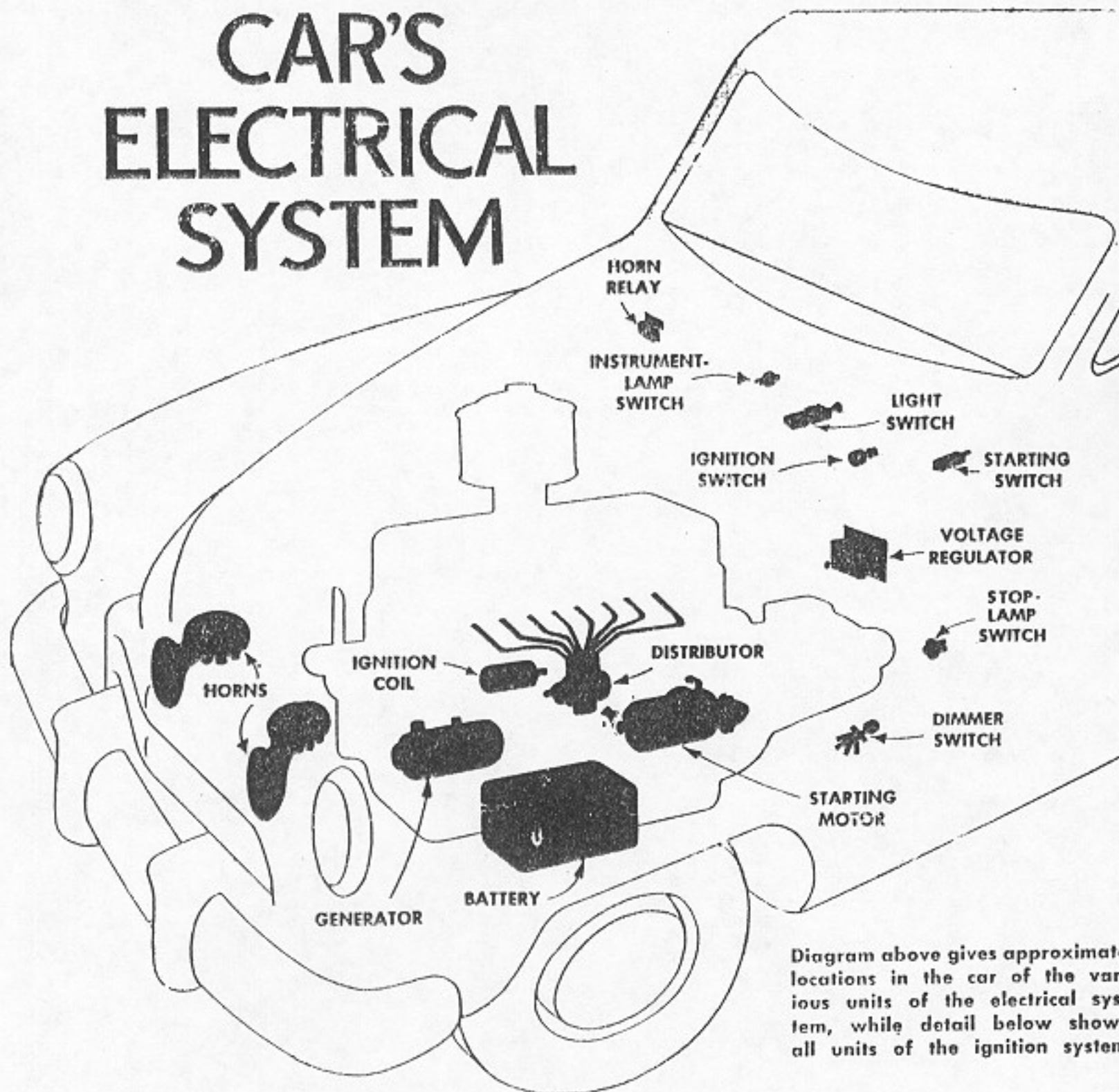
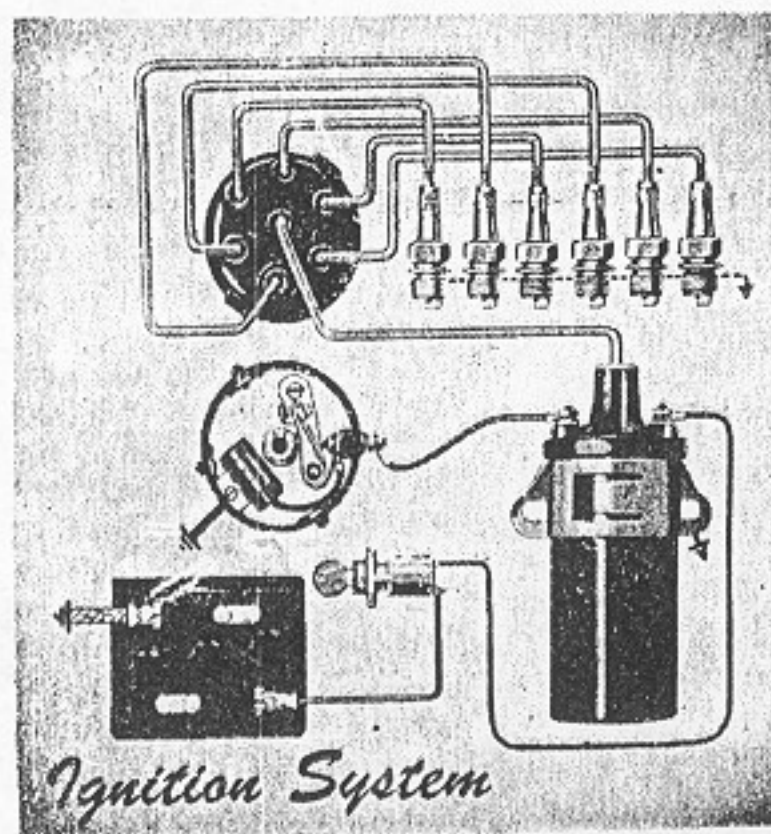


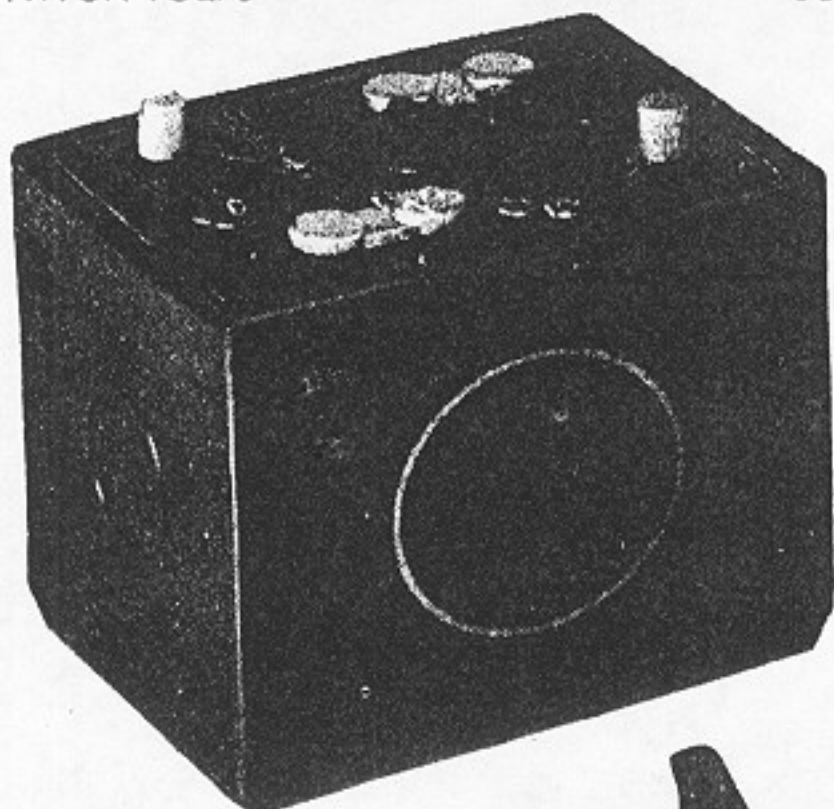
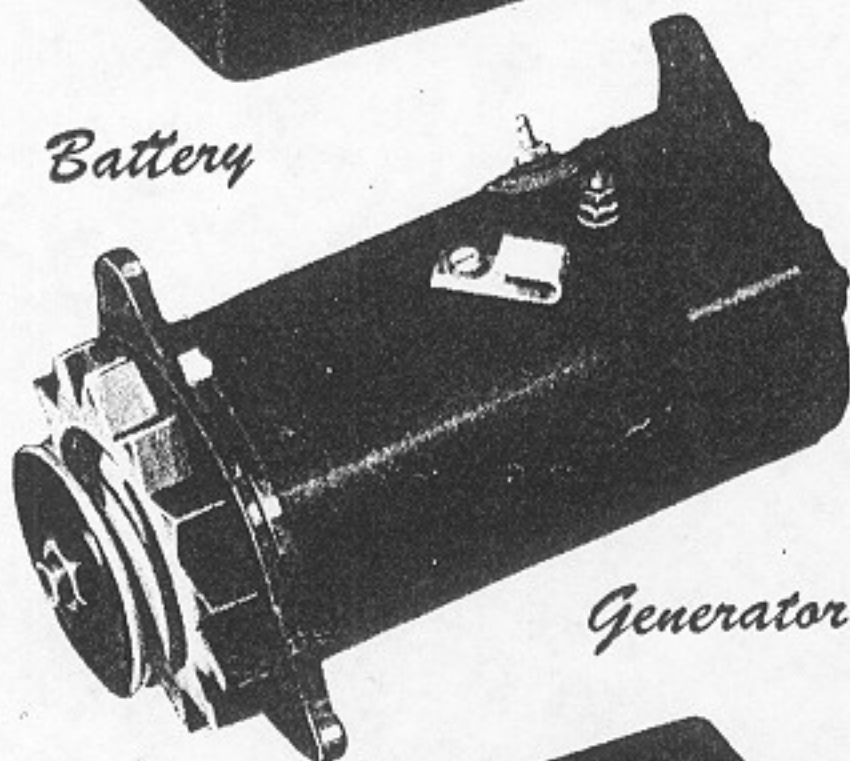
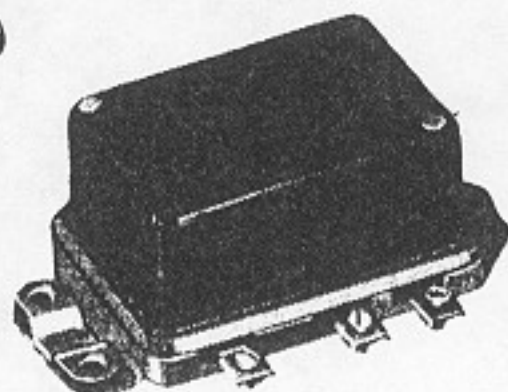
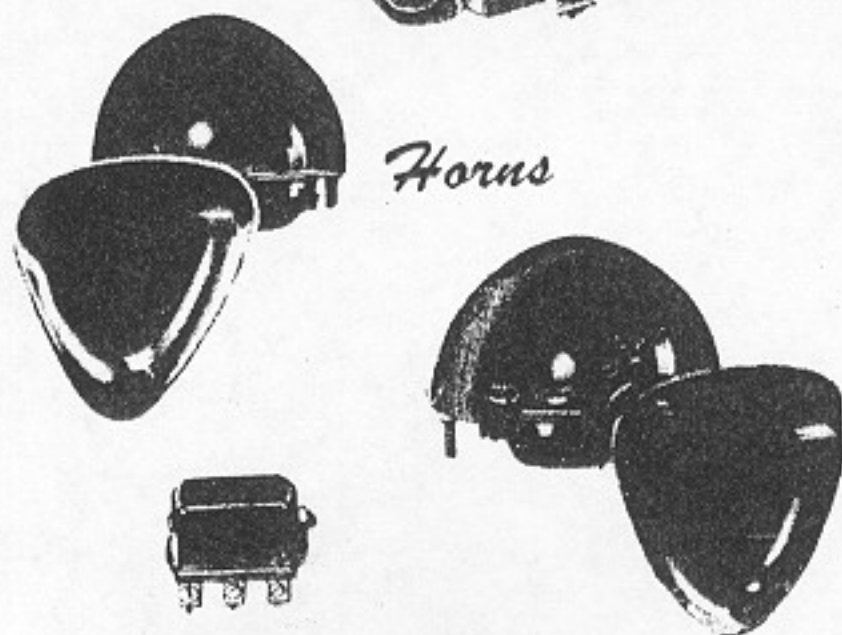
Diagram above gives approximate locations in the car of the various units of the electrical system, while detail below shows all units of the ignition system

KEEPING the electrical system of your car operating at peak efficiency makes a "healthy car" just as a healthy nervous system in your own body makes you feel well; the two are comparable as they both produce the stimulus to make other parts function. Also, both are highly complex and sensitive and are easily thrown out of balance with detrimental results to the parts that depend on them.

Unlike the human nervous system, however, the car electrical system can be understood, adjusted and repaired by the car owner to keep it at peak efficiency.

Often the terms "electrical system" and "ignition system" are confused. Actually the ignition system is only a branch of the electrical system. The diagram above shows the approximate locations of the parts of



*Battery**Generator**Voltage Regulator**Horns**Horn Relay*

the electrical system and the diagram below it shows the part of the electrical system that is called the ignition system. The units composing the basic electrical system, which are pictured on this and the following page, are the battery, generator, coil, distributor, condenser, starting motor, voltage regulator, spark plugs, switches and relays. To these basic units are added the horns, lights, radio and other accessories.

The ignition system, which handles the job of actually firing the fuel charge in the engine cylinders, includes the battery, coil, distributor, condenser, spark plugs and wiring. With the exception of the battery, these units carry high-voltage current, stepped up from a low six volts by the coil to more than 14,000 volts. This high voltage is necessary in order to make the current jump the gap between the spark-plug electrodes and produce a hot spark to fire the gasoline.

Again, comparing the electrical system to the human body, the battery and generator can be considered the heart of the system, the battery storing the electrical energy and the generator producing it.

The battery performs three functions. First, it supplies current for the starting motor and the ignition system when cranking the engine. Second, it intermittently supplies current for lights, radio, heater and other accessories when the electrical demand of these devices exceeds the output of the generator, or when generator output is not available. Third, the battery acts as a voltage stabilizer in the electrical system. Your car cannot operate dependably unless the battery performs each of these functions satisfactorily. Since the battery can supply the electrical needs only for relatively short periods, it is necessary to provide some other means of carrying the electrical load most of the time. This job is handled by the generator, which performs two functions. It supplies all the current needed for operation of the engine and accessories, and produces the electrical energy stored in the battery.

Since the battery and the generator act as a team to provide electrical current whenever needed, it is essential that some type of control be provided between them to coordinate their efforts. This service is performed by the voltage regulator, which is known as the policeman of the electrical system. This unit protects voltage-sensitive units of the electrical system and prevents the battery and generator from damaging each other. When the generator is operating at charging speed, the regulator permits current to flow to the battery to re-

charge it, but it limits the voltage of the generator so that the battery will not be overcharged. It also limits the total output of the generator, when necessary, to prevent overloading. When the generator slows below charging speed, the regulator automatically breaks the battery-generator circuit to prevent a reverse flow of current from the battery to the generator.

The ignition coil acts as the booster for the system. Its job is simply to step up the primary voltage supplied by the battery or the generator into a high-voltage surge, capable of igniting the gasoline vapor in the cylinders. Essentially, it is a transformer.

The ignition distributor is the brain of the system. It times the high-voltage surge supplied by the coil and directs it to the proper spark plug at exactly the right instant to fire each cylinder in its proper turn.

Included in the distributor is a small but indispensable item known as the condenser. It has but one duty and that is to provide a place where primary current can flow until the distributor contact points are safely apart each time they open. This is necessary to prevent a voltage-sapping arc as the points first begin to separate.

The cranking motor, or starter, as it is commonly called, performs only one job—that of cranking the engine.

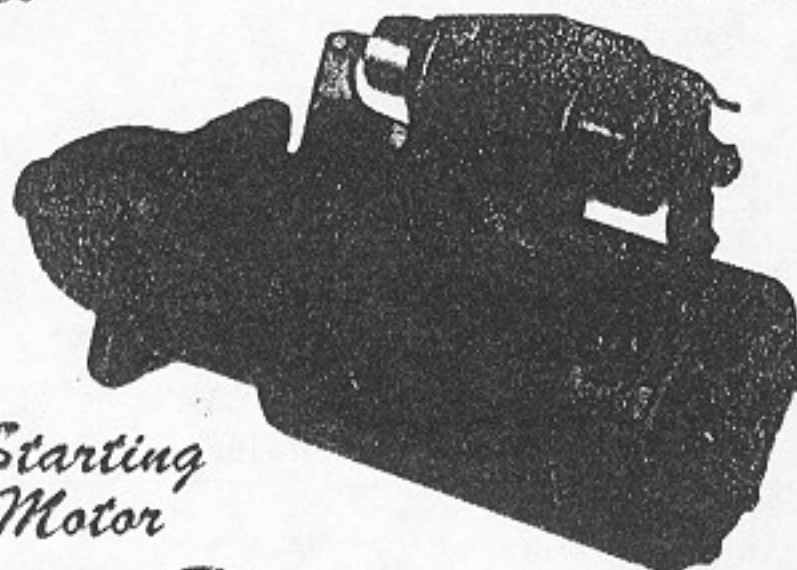
The spark plugs provide an electrical gap in the firing chamber of each cylinder, across which the high-voltage surge can jump, igniting the gasoline vapor, which explodes and drives the piston.

In modern gasoline engines the task performed by the ignition system is staggering to the imagination. For instance, on an eight-cylinder passenger car, the system must produce and distribute 12,000 high-voltage surges per car mile. At 90 miles per hour the ignition system is delivering 300 ignition sparks every second. This means that the entire system must go through its complete cycle of ignition each $\frac{1}{300}$ part of a second.

It is readily apparent, therefore, that anything which can be done to keep the electrical-system units in tiptop condition will be a tremendous aid to better car performance. You will be surprised how much you can do, at home, along this line. The first unit to be described next month will be the storage battery.

A knowledge of how the battery operates will enable you to care for it properly, thus increasing its life as well as making car-starting much easier.

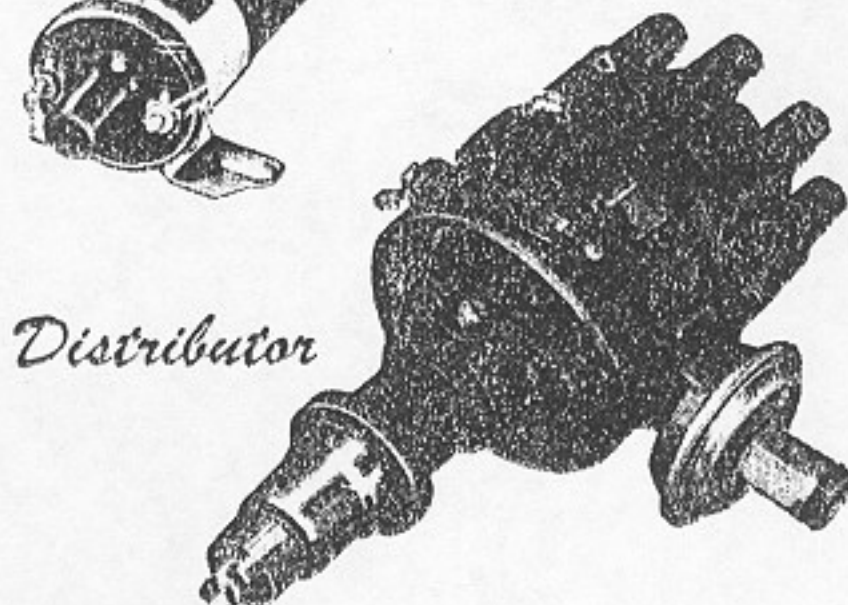
Photos and information courtesy Delco-Remy Division, General Motors Corp.



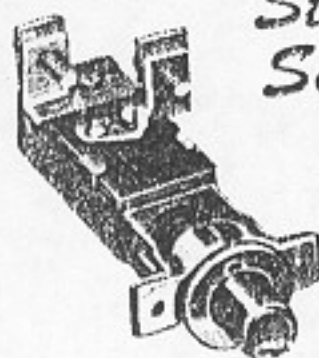
Starting Motor



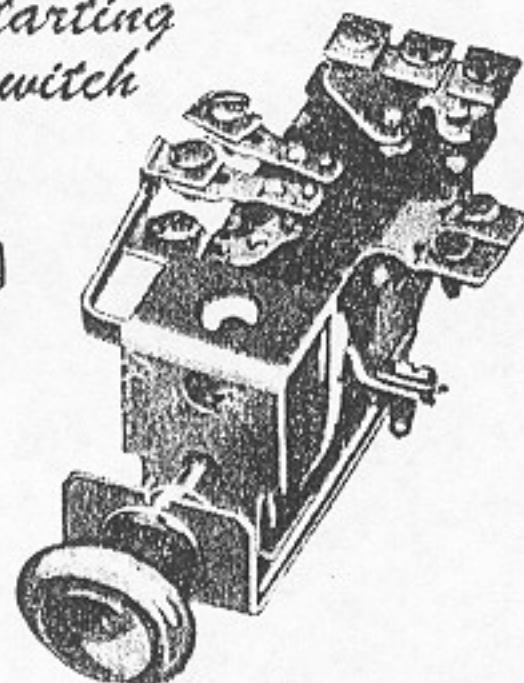
Ignition Coil



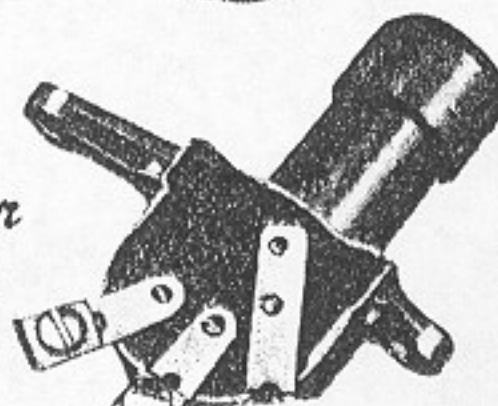
Distributor



Starting Switch



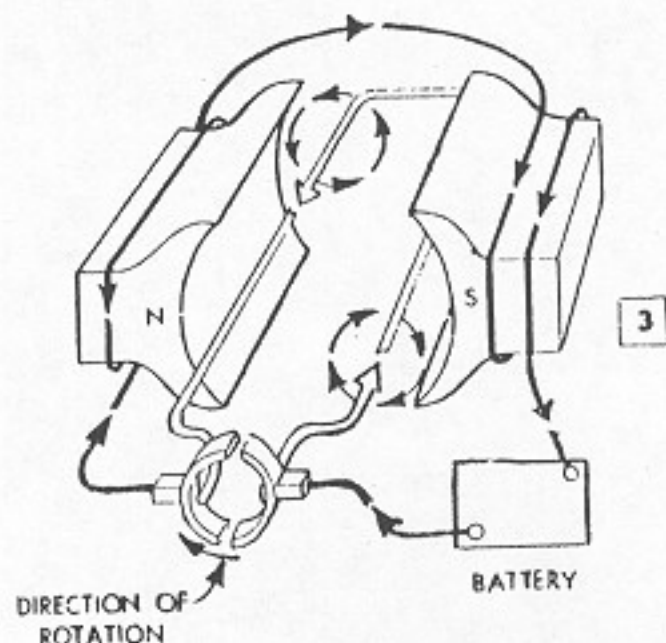
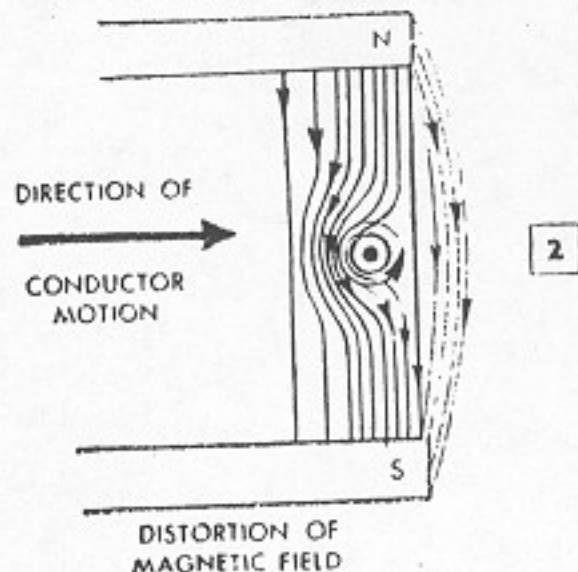
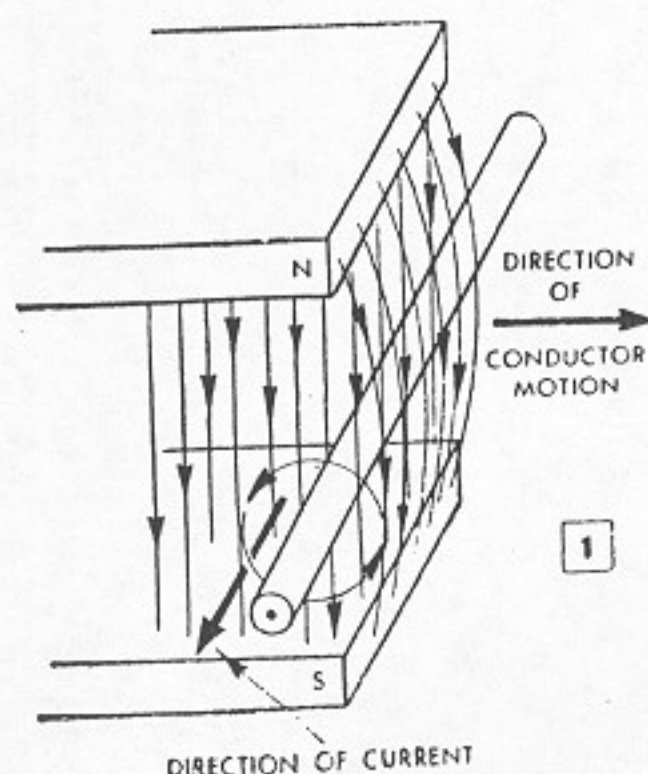
Light Switch



Dimmer Switch

CAR STARTER

The Electric Starter— Operation, Care and Repair



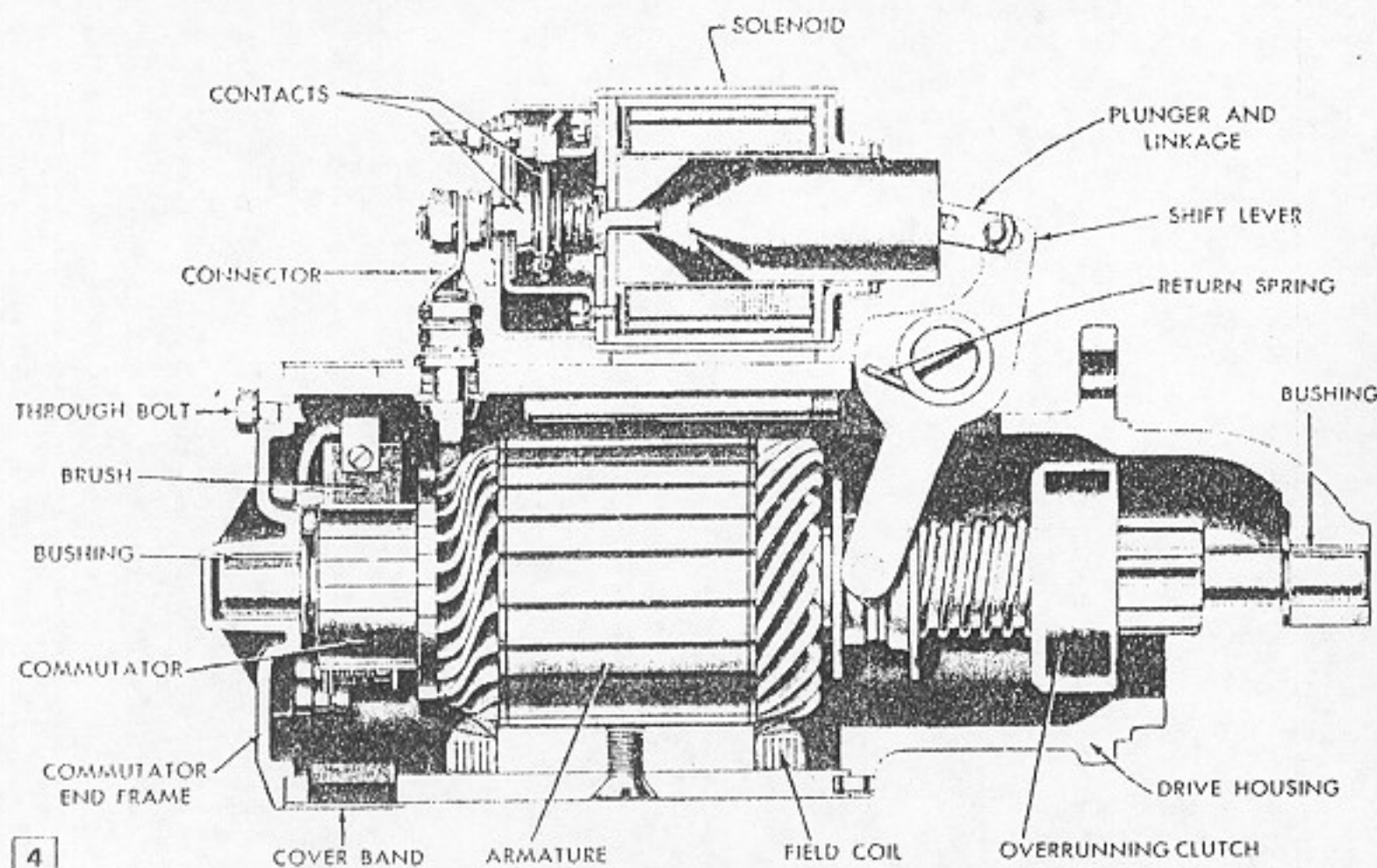
PROBABLY ONE of the units of the automotive electrical system most taken for granted is the cranking motor, or starter. Although it operates only for short periods of time compared with other parts of the car, its successful performance definitely depends on regular checking and maintenance procedures. The armature in this highly specialized unit rotates at about 1500 r.p.m. in order to crank the car engine at 100 r.p.m.

It operates on the principle that opposing magnetic fields tend to attract each other while similar magnetic fields repel each other. Fig. 1 is a simple sketch of a magnetic field from a permanent magnet in which a single conductor has been placed. Current flowing through the conductor in the direction indicated by the heavy arrow causes a magnetic field to circle the conductor as shown by the circular arrows. As a result a force is exerted on the conductor which tends to move it to the right.

Fig. 2 explains this force. The circular magnetic field around the conductor (indicated by the circular arrow) opposes the permanent magnetic field on the right side of the conductor while it aids the magnetic field to the left of the conductor. Opposition to the magnetic field on the right tends to cancel it, so there is less magnetism to the right of the conductor than there is to the left. The magnetic lines of force are thus distorted around the conductor and exert a thrust on it.

Fig. 3 is a drawing of a simple electric motor with a one-turn armature which indicates how the sidewise thrust on the conductor causes it to rotate and crank an engine. The armature is a single loop of wire suspended between two magnetic poles. The magnetic field of each pole is reinforced by the field coil wound around it. When the circuit between the battery and the motor is closed, current flows from battery through the armature loop, then through the field-coil windings and back to the battery as shown by arrows. On the left-hand side of the armature loop current is flowing in the direction of the loop arrows, which causes an upward thrust on that half of the armature. Since the current is flowing in the opposite direction through the other half of the armature, the thrust on it is downward. These opposing thrusts

The Starter



cause the armature to rotate in a clockwise direction.

A powerful cranking torque is produced by using many windings in the armature, instead of the single loop of wire, thus multiplying the thrusts on the armature. Fig. 4 is a sectional view of a typical modern passenger-car starter.

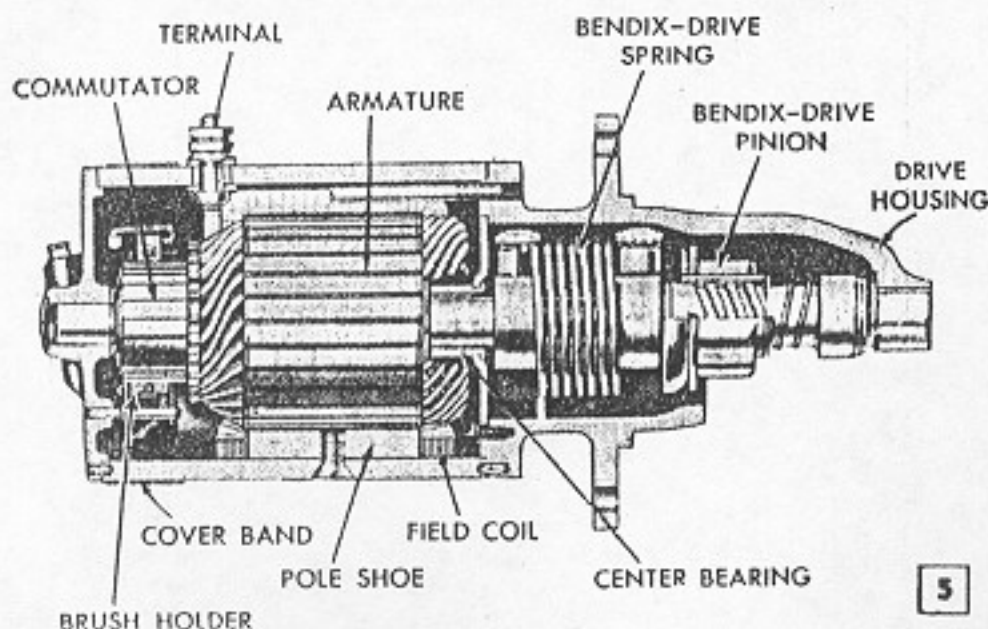
All passenger-car starters are much the same in general design and operation, differing mainly in the type of drive used. The drive mechanism has two functions—to transmit the cranking torque to the engine flywheel and to disconnect the starter from the flywheel after the engine has started. Most passenger cars use either the Bendix or the overrunning-clutch type of drive.

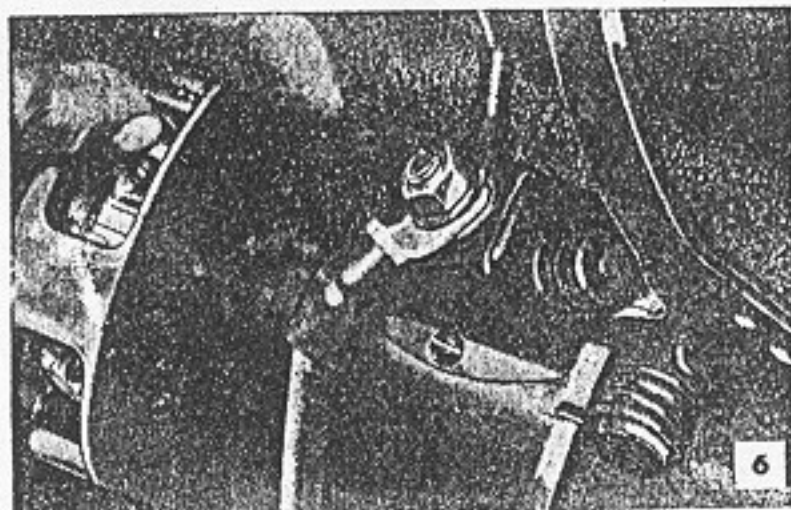
A typical Bendix-drive starter is shown in Fig. 5. This drive depends upon inertia to mesh and unmesh the starter drive pinion from the engine-flywheel ring gear. When this type of starter is not operating, the pinion is out of mesh with the flywheel ring gear. As soon as the starter switch is closed, the starter armature begins to rotate and moves the pinion into mesh with the flywheel.

The overrunning-clutch type of drive, Fig. 4, is shifted

mechanically into mesh with the flywheel. This may be done directly by foot pressure on a pedal or by a solenoid switch controlled from the dashboard. Completion of the shift in either case closes the circuit between the starter and the battery. The pinion maintains contact with the flywheel ring gear until the pedal or switch is released.

Briefly, the overrunning clutch consists of a shell-and-sleeve assembly—in which is fitted a pinion-and-collar assembly, Fig. 7—that rotates with the armature. Four tapered slots in the face of the shell take spring-loaded steel rollers. When the shell is rotated by the starter motor, the rollers move into contact with the collar, jamming tightly against it and forcing it to rotate





with the shell, thus cranking the engine. When the engine flywheel rotates faster than the shell, the rollers move back in the slots, disengaging the collar and shell so the shell overrides the collar and disengages the starter from the engine.

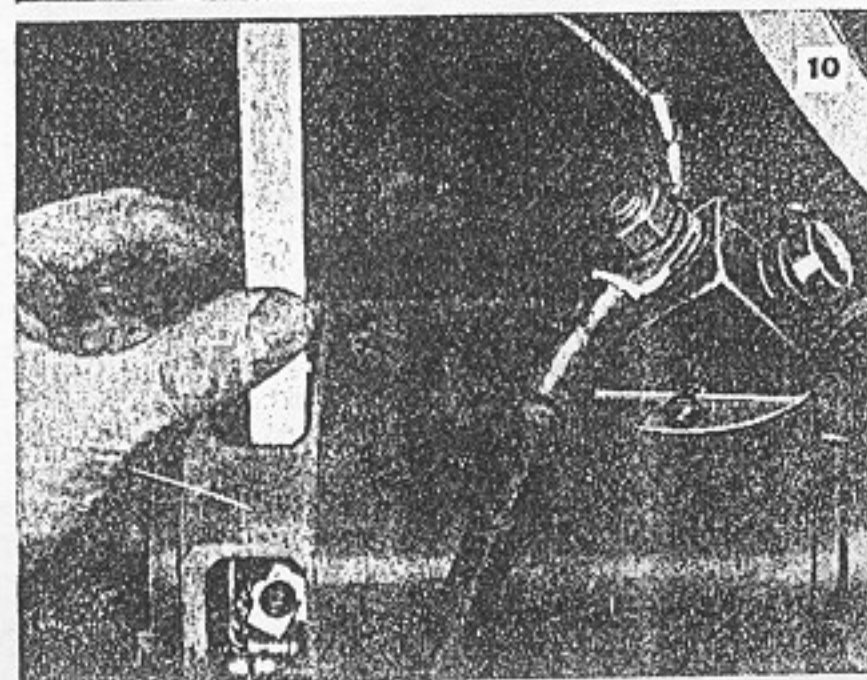
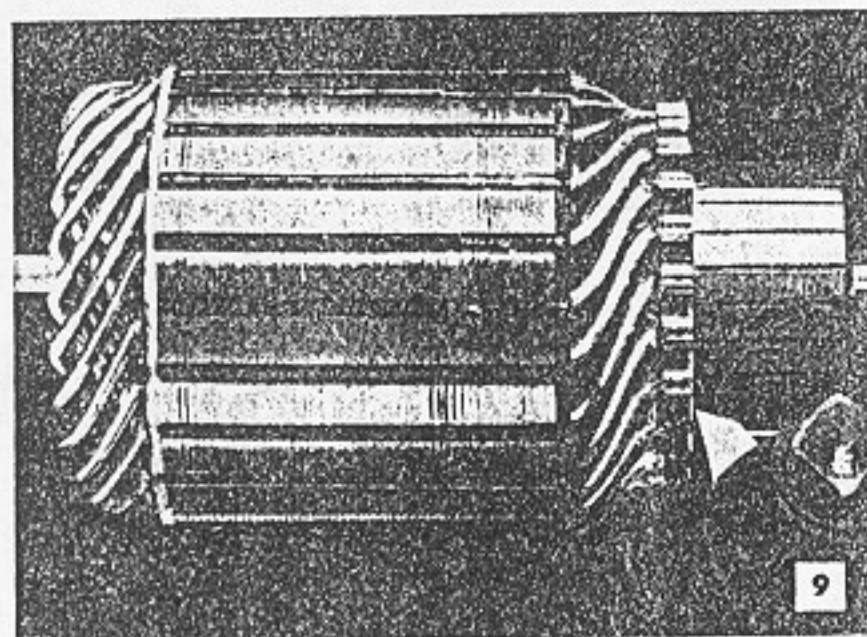
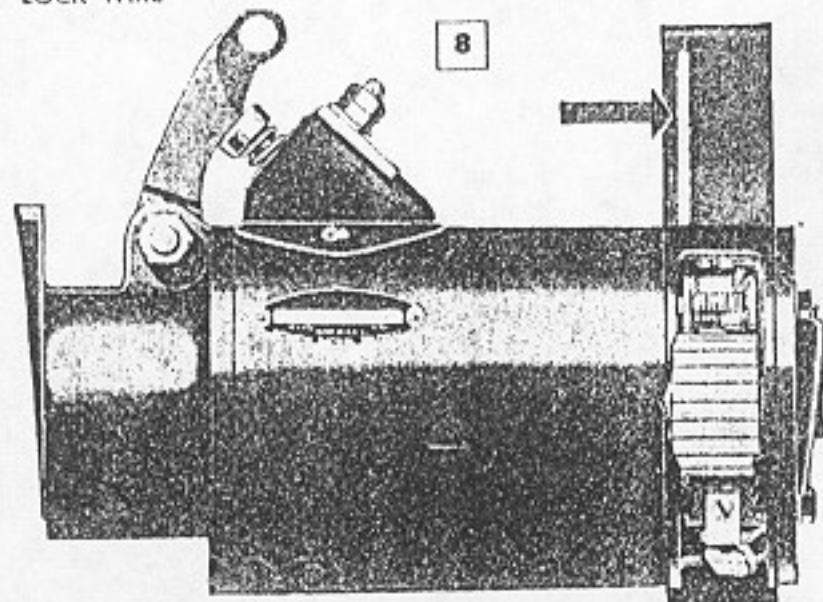
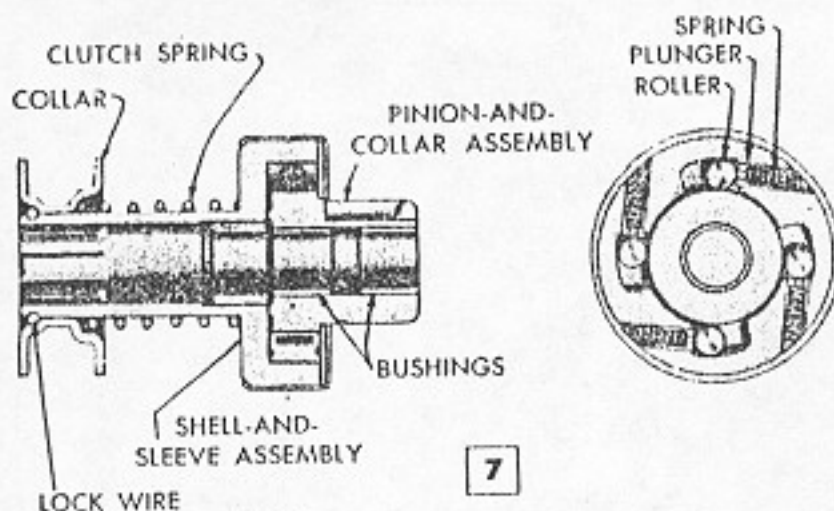
Obviously, as soon as the engine begins to operate, the starter switch or pedal should be released. Otherwise the drive pinion remains in mesh and continues to overrun the armature, which will cause overheating.

Quick checks and maintenance procedures: Armed with a working knowledge of the operation of his car's starter, a motorist can do much to assure a long and dependable life for the starter. The following trouble shooting, inspection and maintenance procedures can be followed easily without specialized equipment or tools.

To make a quick check of the starter system, turn on the headlights. If they do not burn with normal brilliance, the battery should be checked. If the battery is in a charged condition and the lights burn brightly, operate the starter. One of these things will happen to the lights: They will go out, dim considerably or stay bright with no cranking action taking place.

1. If the lights go out, there is a poor connection, which usually will be found at the battery terminals, between the battery and the starter. Correction is made by removing the cable clamps and cleaning both the clamps and terminals. After reconnecting and tightening the clamps, a corrosion inhibitor such as petroleum jelly should be applied.

2. If the lights dim considerably, the battery may be discharged or there may be some mechanical fault in the engine or starter which is throwing a heavy burden on the starter. Check the battery first. If it is in good condition, the trouble is in either the engine or the starter. In the engine, tight bearings or pistons or extra-heavy oil may be causing the added strain on the starter. Low temperatures cause engine oil to thicken and make the engine more difficult to start. Low temperatures



also lessen the effectiveness of the battery. In the starter, look for a bent armature shaft, loose pole-shoe screws or worn bearings. Any of these will cause the armature to drag and reduce starting performance.

Occasionally, more serious internal damage may be found. Thrown armature windings or commutator bars, which sometimes occur on overrunning-clutch-type starters, usually are caused by excessive overrunning after starting.

On Bendix-drive starters, broken Bendix housings and "wrapped up" Bendix springs may result if the driver closes the starter switch during engine "rock back," which occurs when the engine starts automatically, then stops again. Another cause may be engine backfire resulting from ignition timing being too far advanced. To avoid such failures, the driver should pause a few seconds after a false start to make sure the engine has come to rest completely.

Frequently, a worn pinion gear in a Bendix drive will jam into mesh with the flywheel ring gear and refuse to unmesh. If this happens, put the car in gear and manually rock it forward and backward.

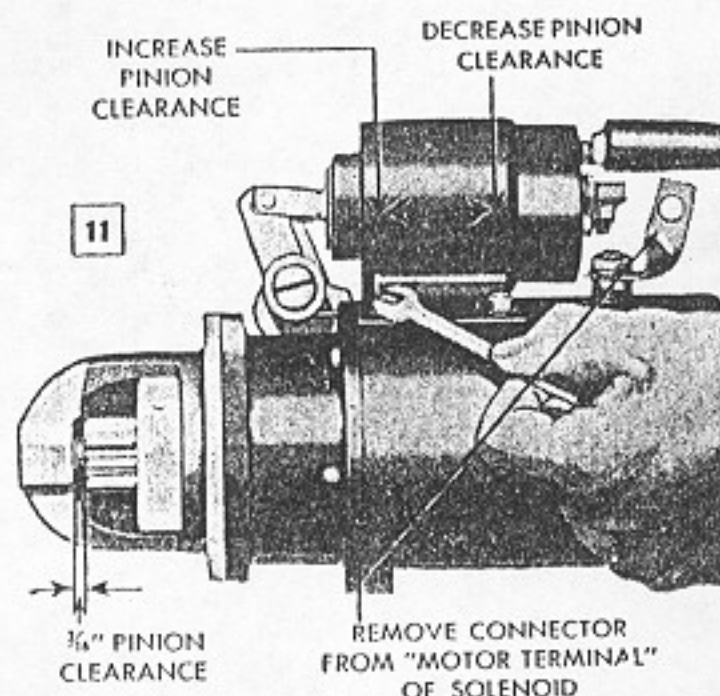
3. If the lights stay bright and no starting action takes place, an open circuit at some point is indicated. This may be in the starter, in the starter switch or in the control circuit. Where the starter is operated by a solenoid switch, temporarily eliminate the solenoid circuit by placing a heavy jumper lead across the solenoid's main terminals to see if the starter will operate. This connects the starter directly to the battery. If the starter operates, the control circuit is not functioning normally. If the starter does not operate, the trouble most likely will be found in it.

Every 5000 miles, under normal operating conditions, inspect the mounting, wiring and connections to make sure they are in good condition. The magnetic switch or solenoid should be mounted firmly and should operate freely, without binding.

Next, remove the cover band so the commutator, brushes and internal connections can be checked, Fig. 6. Examine the cover band for thrown solder, Fig. 8 (arrow), which results if the starter is subjected to such excessively long cranking periods.

Check the brushes to see that they are not binding and that they are resting on the commutator with sufficient tension to give good, firm contact. Make sure brush leads and screws are tight. If the brushes are worn down to half their original length, they should be replaced.

Note the condition of the commutator. If it is glazed or dirty, it can be cleaned quickly by holding a strip of No. 00 sandpaper against it with a piece of wood, Fig. 10, while the starter is operated. A brush-

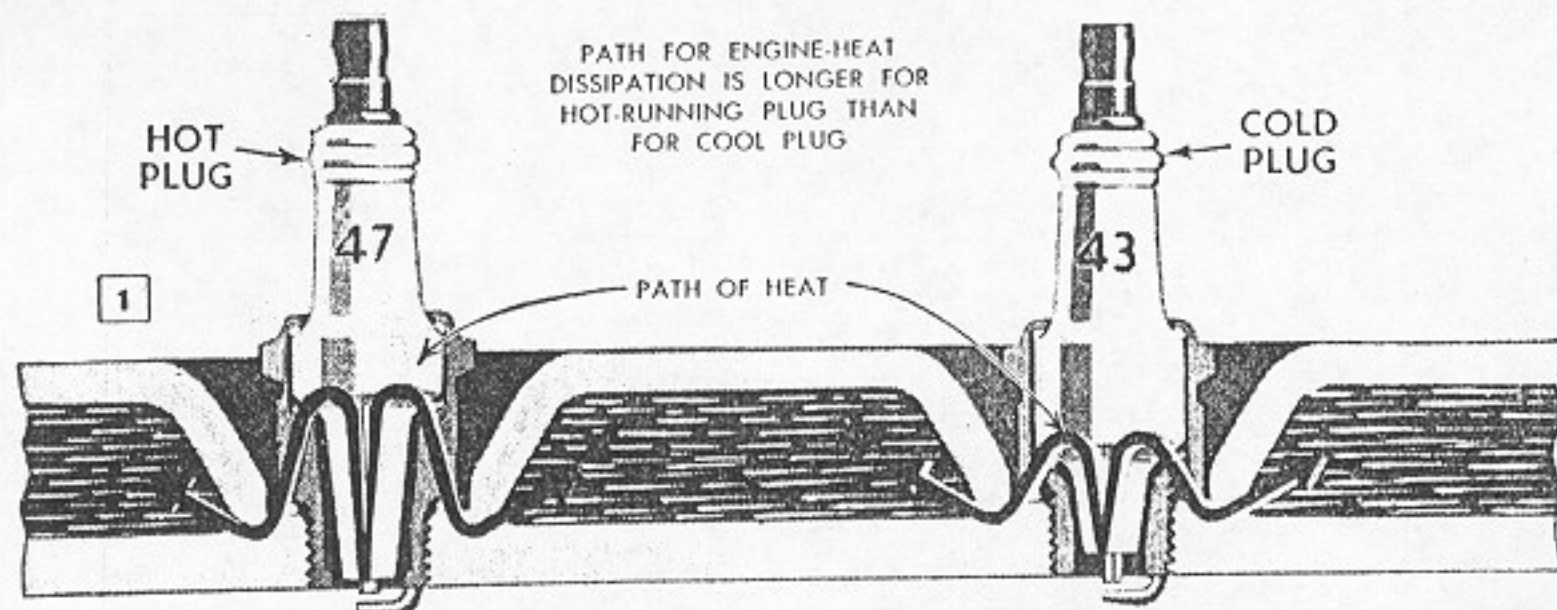


seating stone may be used for the same purpose. Move the sandpaper or stone across the face of the commutator as it spins. Blow out all dust after the commutator is cleaned. Always remember never to operate any starter for more than 30 seconds to maintain an accurate adjustment of the pinion clearance. Fig. 11 shows the proper method of making this adjustment. Remove the connector from the "motor" terminal of the solenoid. Place a piece of $\frac{3}{16}$ -in. bar stock or a $\frac{3}{16}$ -in. gauge between the pinion and the housing. Connect a six-volt battery across the "switch" terminal of the solenoid and the solenoid base (ground) and push the solenoid plunger in by hand. Battery current will hold the plunger in the "bottomed" position while the pinion clearance is adjusted. Loosen the solenoid-switch mounting and pull the switch away from the shift lever until play is taken out of the lever and the clutch mechanism. Be careful not to compress the overrunning-clutch spring. Moving switch toward the lever increases clearance; moving switch away from the lever decreases pinion clearance. Then tighten the switch-mounting screws and replace connector at "motor" terminal of the solenoid.

This adjustment must be made each time after the armature is removed from the starter for any reason. Unless it is correctly adjusted, the solenoid cannot operate properly. Starters equipped with hinge-cap oilers should have 8 to 10 drops of light oil each 5000 miles.

Some models are equipped either with oil wicks to lubricate the center and drive-end bushings or with oilless bushings. Oilless bushings should be supplied with a few drops of light engine oil whenever the starter is disassembled for repair or service.

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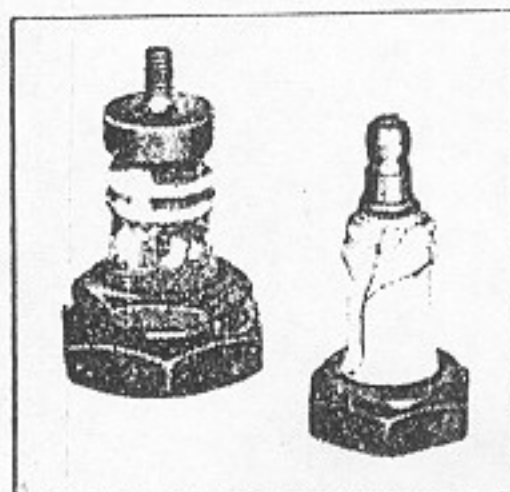
SPARK PLUGS

REGULAR servicing procedure applies to the spark plugs, just as it does to all other parts of the car that require periodic attention. Plugs should not be removed, cleaned and adjusted by a haphazard schedule. This may often do more harm than good as frequent removal and reinstallation of plugs is ordinarily unnecessary and causes undue wear on the threads of both the plug and cylinder head. This is especially true when the car is new, unless, of course, faulty engine performance at some time during the first few thousand miles fouls the plugs. In older cars the plugs, and also the ignition system, require a careful check more often to keep these parts performing properly. Badly worn pistons, cylinders and rings accelerate wear on the plugs. On the average, plugs need a careful check every 3000 to 5000 miles, and should be replaced with new ones every 10,000 miles. They will run longer, of course, but with greatly reduced efficiency. At the regular checks of other parts of the car examine each plug to see that the exposed portion is clean

and dry, and that the plug wire snaps over the terminal firmly and with a clean connection, Fig. 10. Other parts of the ignition system should be inspected regularly to assure delivery of the normal high-tension current to the plugs.

The basic parts of a plug are shown in the cross-sectional drawing, Fig. 2. Inspection of these parts will tell a lot about how the plug is performing and what to do about correcting any trouble that may develop. The six photos below picture some of the common causes of plug failure.

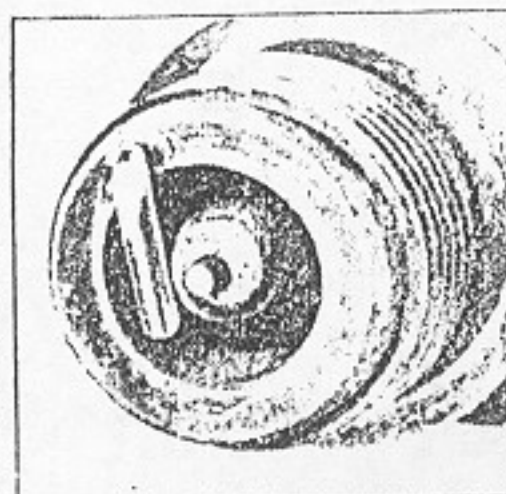
A plug must run hot at low engine temperatures, and cold at high engine temperatures. The running temperature of the plug must be sufficient to burn off ordinary carbon deposits but not so high as to cause detonation, pre-ignition, fusing or blistering of the insulator, or rapid erosion of the points. To obtain the right plug temperature, use a plug of the correct "heat range." This is determined from the type of engine and the operating conditions. When buying a set of plugs, remember there are three "heat range" types—hot, normal



Cracked, dirty insulators affect engine performance, cause compression leaks, shorts, fuel waste



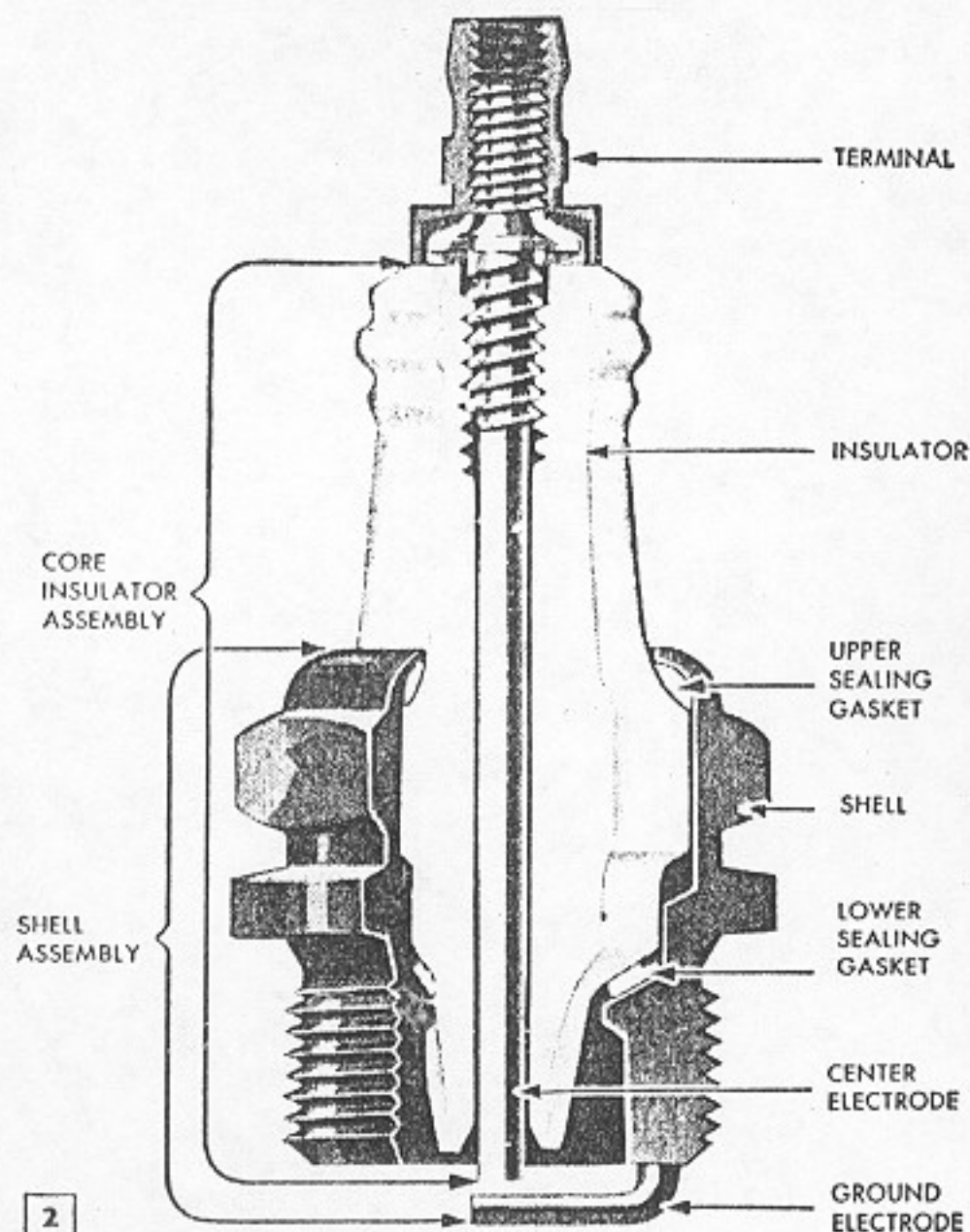
Plug has been running too cool. Shell, electrodes and insulator are fouled with hard carbon deposits



Insulator eroded by oxidation. Tends to short the plug, causing the engine to miss at high speeds

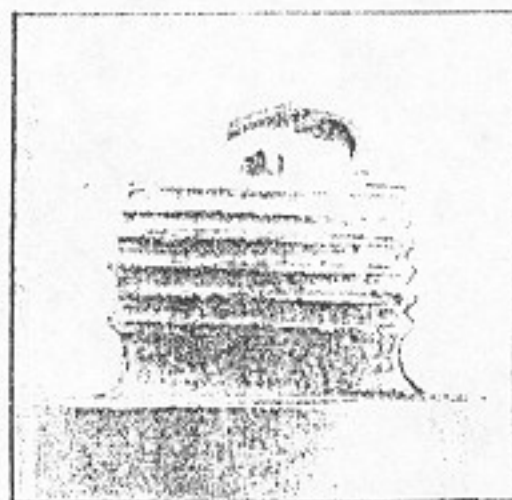
Clean plugs, properly chosen for heat range, give peak engine performance with very substantial savings in fuel and oil consumption and reduce costly repairs

and cold. The hot plugs, Fig. 1, have a long insulator with a correspondingly longer path for the dissipation of heat to the engine block. The insulator on the cold plug is short, heat is dissipated rapidly, and it operates much cooler. A plug operating at the correct temperature will have a soft, powdery deposit on the nose of the insulator—either a grayish tan or rusty brown in color. Wear of the points will be normal and confined to the faces of the spark gap. If point wear is rapid while the color of the insulator is normal, the gap may be incorrectly set or the fault may be in the wrong type of coil. It's well to keep in mind, too, that in old cylinder heads there is the possibility that water passages near the plug may be partially or wholly blocked with hard deposits, causing a hot spot in the head that may affect the plug. Plugs operating too hot will show

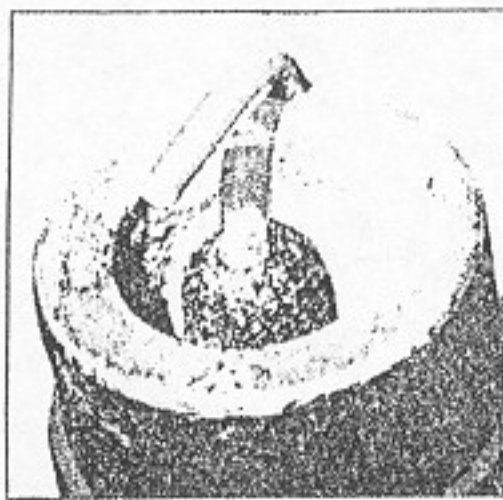


dark spots or blisters on the insulator nose. The points will be badly burned, in proportion to the length of time the hot condition has existed. Fused and glazed deposits on the insulator may "short" the current and cause misfiring.

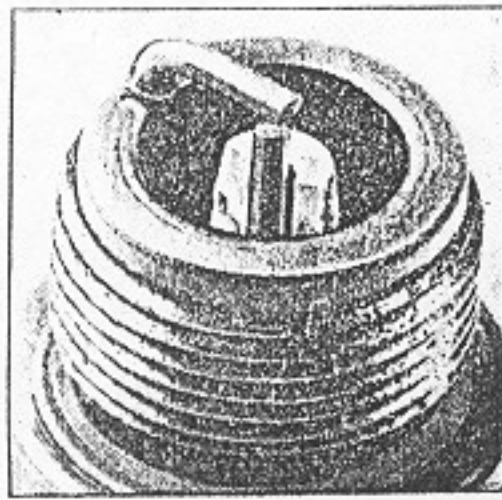
Often a plug will be of the correct heat type for a particular engine and still run hot. In this case, the plug may not be tightened sufficiently, permitting hot gases to



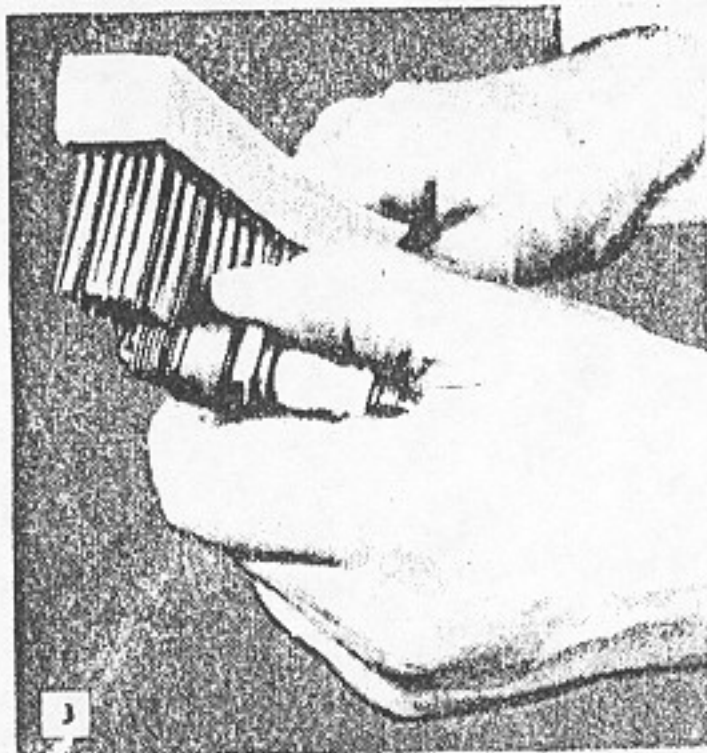
This happens when a plug runs too hot. Undue wear of the electrodes shows in comparatively short time



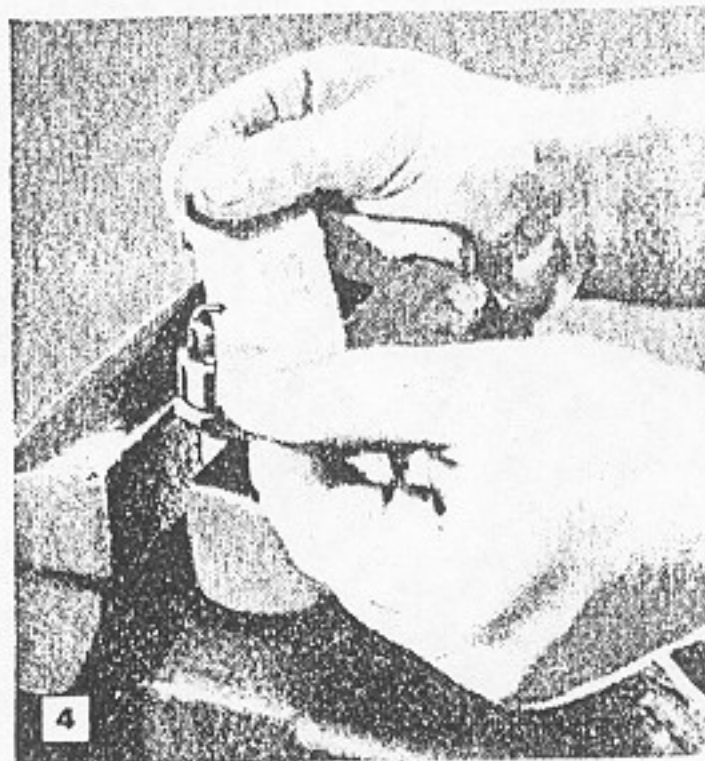
According to reliable tests, plugs in this condition may waste as much as one gallon of fuel in ten



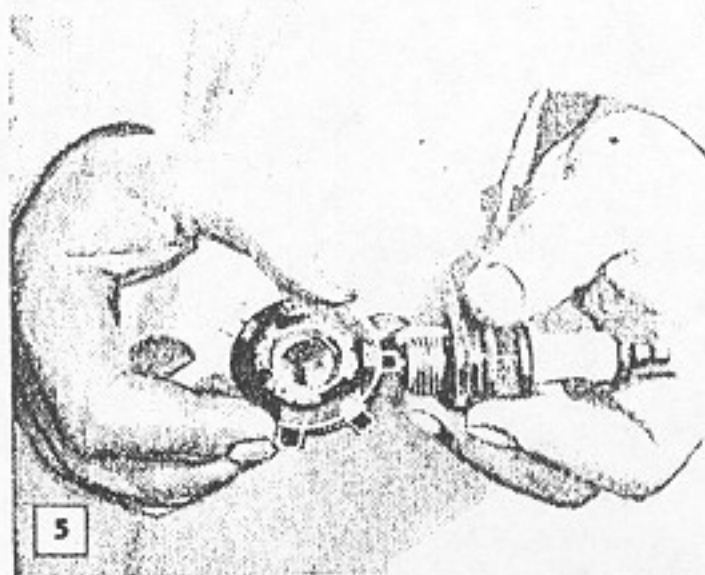
Insulator broken at the lower end may be due to hot operating conditions or careless installation



3 Clean the threads of the shell thoroughly. Carbon deposits here will retard dissipation of heat



4 Shallow-pitted electrode points can be restored by the careful use of fine-grit abrasive or a file



5 Use a round gauge to check the gap. Adjust to exact distance recommended by the manufacturer

escape and heat the plug in passing out. There may be gas leakage between the insulator and the electrode, or between the insulator and the shell. This condition can be detected by soot streaks on the outside portion of the insulator. A lean fuel mixture, wrong ignition timing, poorly seating valves and other faulty engine conditions, can cause plug overheating. Plugs running too cold will be sooty, gummy and possibly oily. Oil pumping from the crankcase, too rich a fuel mixture and long idling periods will cause this condition. Fuel fouling is indicated by a dull, black, fluffy deposit; oil fouling, by a shiny, black, hard deposit. In judging plugs for heat range, be sure normal operating conditions have existed for a time before making the inspection. Otherwise, one may get a false interpretation of the average plug needs of the engine.

Although servicing a spark plug looks simple enough, there is danger of permanent damage to the plug unless certain precautions are carefully followed. Use a socket wrench of the correct size to remove the plug—never use an end wrench or other makeshift wrench that is likely to burr the plug nut or slip off and break the insulator. Blow dirt out of the plug well before removing the plug to prevent it from falling into the cylinder. Condition of the gasket is important. Inspect it carefully each time the plug is removed. It may be the key to plug trouble or poor engine performance. If the gasket is flattened or badly scored, it may be the cause of a baffling compression leak as well as a hot plug. On the other hand, if the gasket is still rounded, it is probable that the plug has never been correctly tightened. This condition may also be the cause of a hot plug or a compression leak. If there are indications of soot and burning on the gasket, it was not tight enough to seal. The gasket serves the dual purpose of sealing engine compression and acting as a bridge for the dissipation of heat.

After removing and inspecting the plug and gasket, clean the shell threads, insulator and



6 Before replacing a plug, turn a new gasket over the threads by hand. Make sure gasket is properly seated

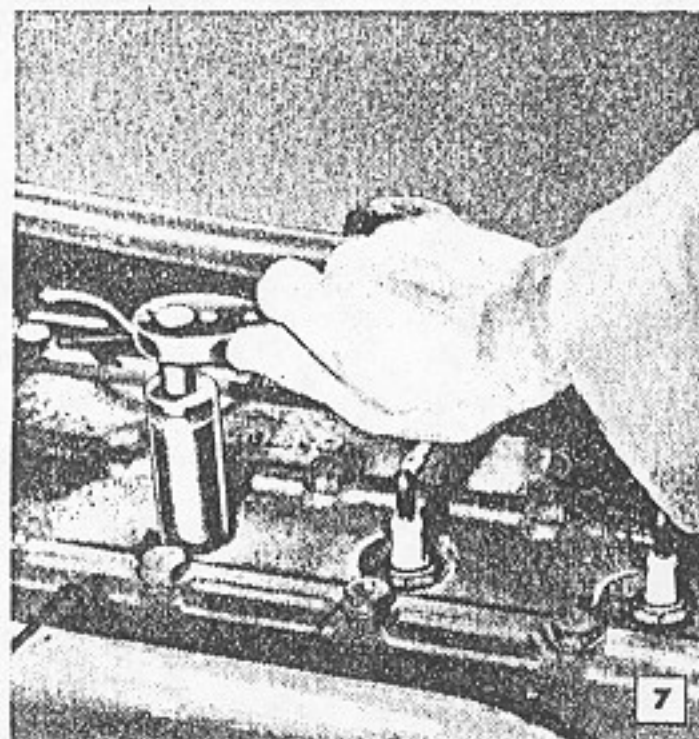
points carefully as in Figs. 3 and 4. Or if desired, take the plugs to a service station equipped with a spark-plug cleaning machine. If the insulator is badly fused, cracked or blistered, the plug should be replaced. Plugs with badly corroded and worn points also should be replaced. Adjust points to the correct spacing by bending the side electrode, never the center one. Use a round gauge, Fig. 5, to check the gap setting recommended by the car manufacturer.

When installing the plug, always use a new gasket and turn it over the shell threads as in Fig. 6. Before screwing the plug into the cylinder head clean the gasket seat with a cloth as in Fig. 8. Turn the plug in by hand, making sure the thread is not crossed and the gasket is not cocked at an angle. Snug it up by hand also, then tighten with a socket wrench only one half to three quarters of a turn, Fig. 7. Wipe the insulator as in Fig. 9 and be sure to connect the correct wire to each terminal.

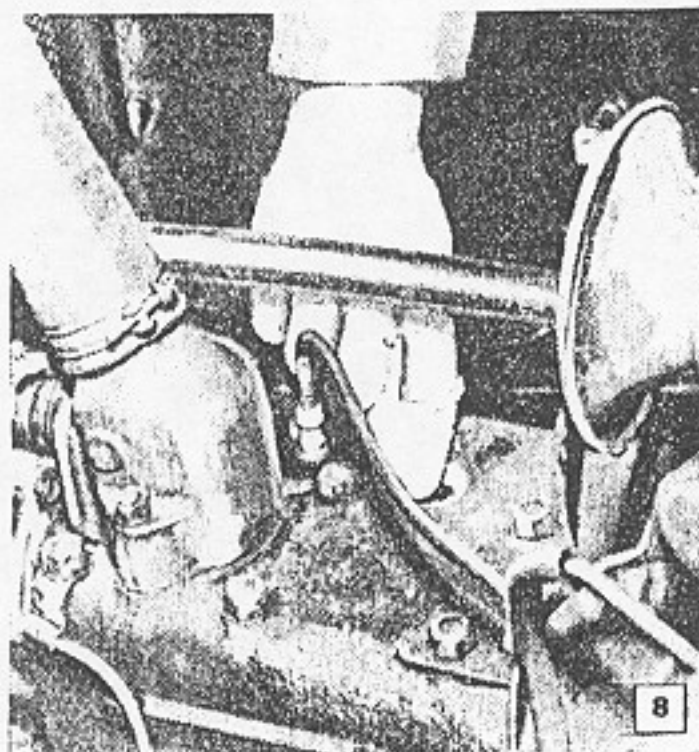
If plugs foul in a new engine, check for wrong lubricating oil in the gasoline for run-in purposes; carburetor adjustment out; improper choke adjustment; car driven too slowly during break-in period; distributor points incorrectly set; coil or condenser weak; plug gap set too close. If the engine misses at high speeds or under a heavy load, check these common causes: distributor points dirty, glazed or incorrectly set; weak coil or condenser; carburetion incorrect; valve-tappets out of adjustment; plug gap set too wide; overheated plugs, calling for cooler plug in the heat range, overheated plugs due to gasket leakage or other causes.

If the engine "rolls" when idling, check the carburetor adjustment; distributor points; coil; engine compression; valve-tappets; improper valve timing; sticking valves and the plug gap. When making any inspection with the plug removed, always check the gap.

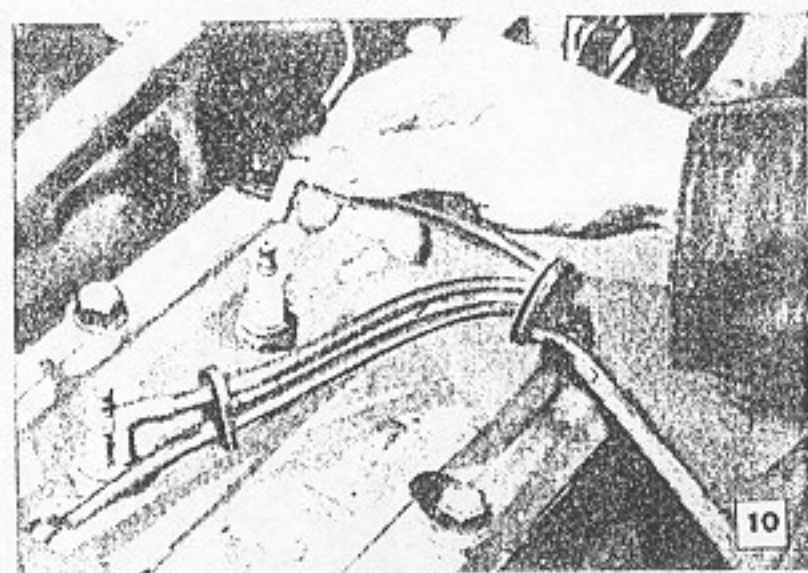
Certain photos and details by courtesy of A.C. Spark Plug Div., General Motors Corporation; Champion Spark Plug Co., and The Electric Auto-Lite Co.



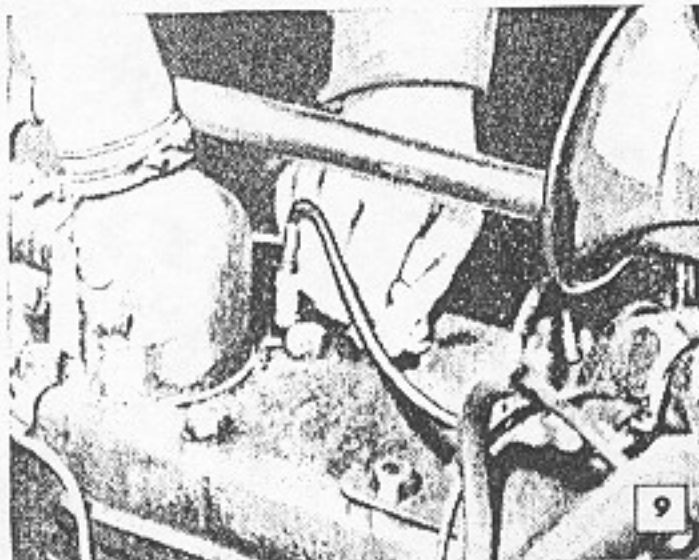
When removing or tightening plugs, use a socket wrench. Other wrenches may burr the hex section



Wipe the gasket seat with a clean cloth before installing plug. Avoid pushing dirt into opening

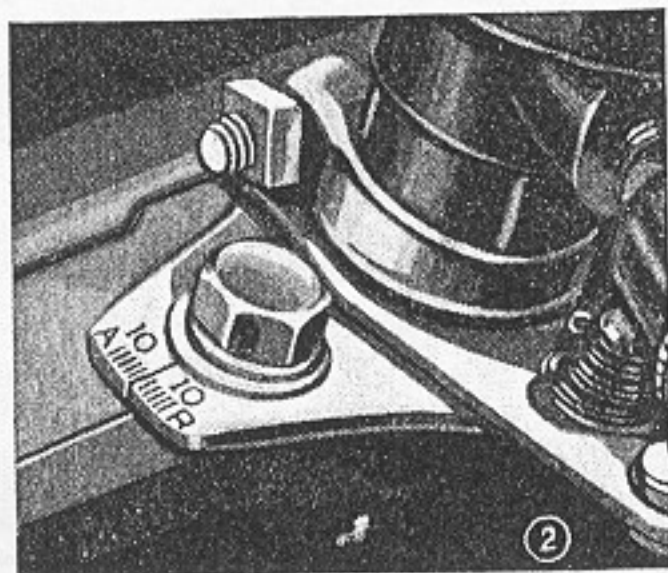


It's very important to attach the correct ignition wire to the terminal after cleaning and installing the plug



Clean the insulator after installing the plug to prevent shorts through caked dirt or hard grease

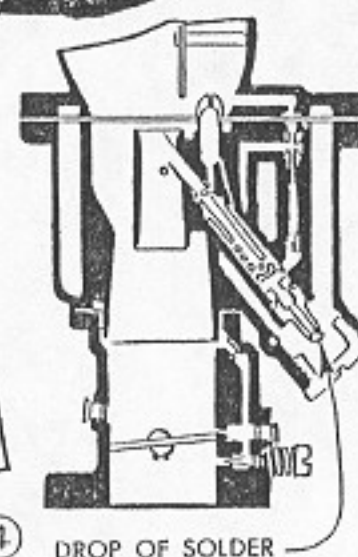
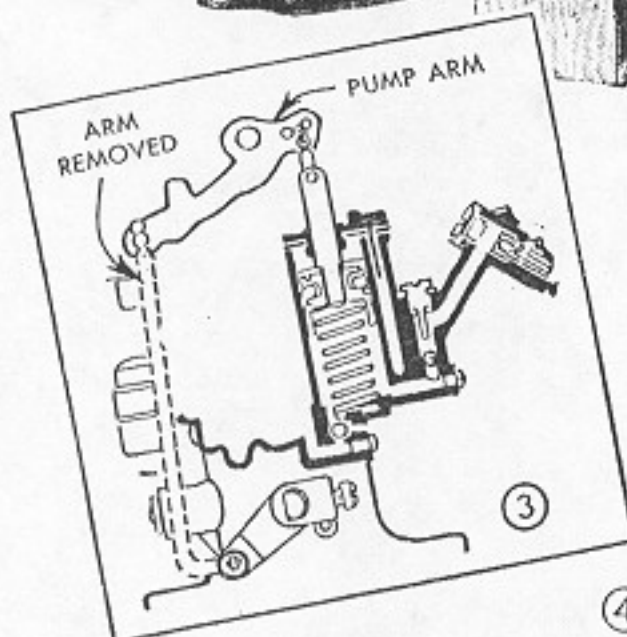
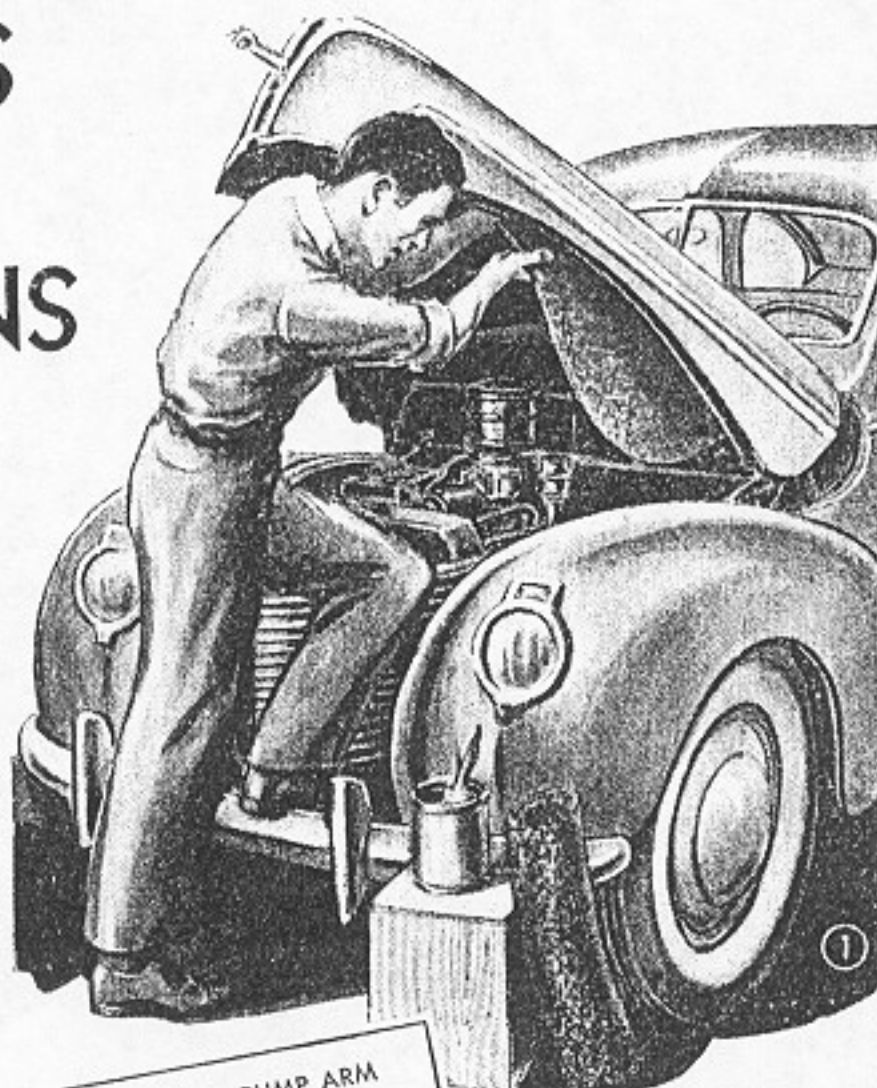
MORE MILES *from your* GAS COUPONS



By C. E. Packer

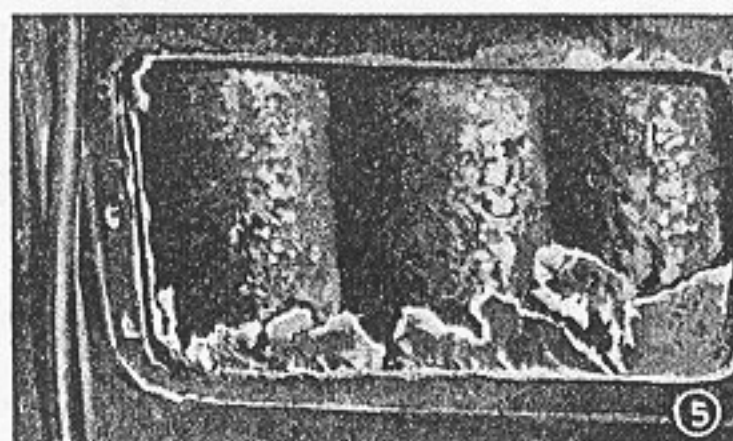
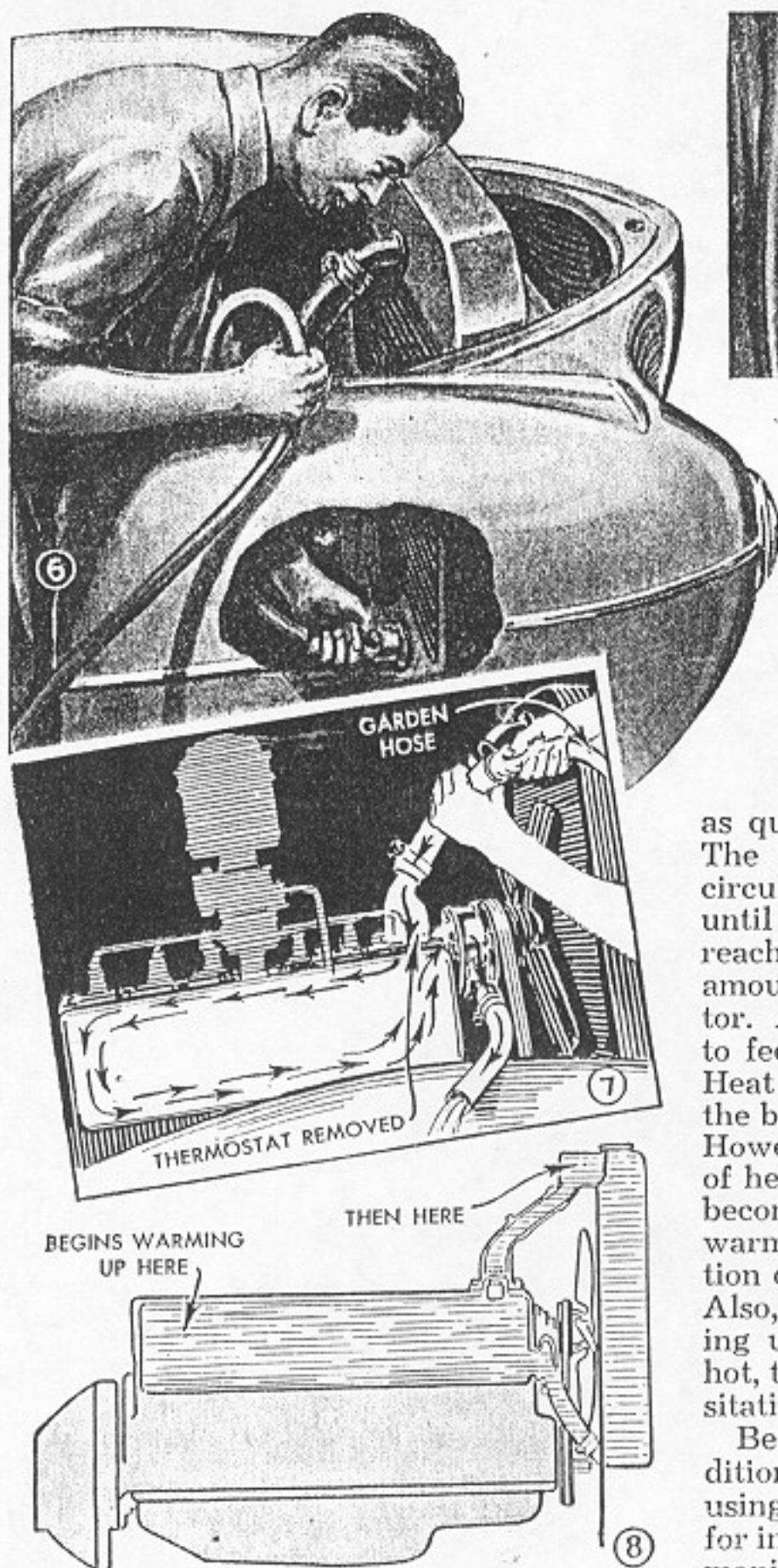
EVERY motorist realizes that peak performance of his motor plus sane, careful driving are necessary for minimum gas consumption. But, in these days of reduced speeds and mileage, keeping a motor at peak performance may be expensive and the labor shortage now evident in service work may make it impossible to keep your motor at its best. However, there are a number of things that any car owner can do to "stretch" his gasoline coupons. For example, one motorist found that it was an advantage to insulate the inside of the hood and the outside of the crankcase with thick felt building paper as shown in Fig. 1, besides, of course, using a radiator cover, to help keep the motor and oil warm while the car was parked during cold weather.

Adjusting ignition timing so that the motor will "ping" under rapid acceleration is another way that you can get maximum power out of each drop of gas. This is done by advancing the spark, Fig. 2, until you hear a ping when the throttle is opened quickly while traveling at the rate of 15 m.p.h. in high gear with the motor completely warmed to operating temperature. As all modern types of carburetors have three distinct jets that function at different car speeds, closing two of them often results in an appreciable saving of gasoline. There is a low-speed jet, which handles the



car up to speeds ranging from 25 or 30 m.p.h., a high-speed jet that operates at higher speeds, and a power jet located at the bottom of the accelerator well, which functions when accelerating, and also contributes to speed performance. By closing the latter two jets with a drop of solder on each one, Fig. 4, only the low-speed jet is left to function. If this is done, and there is no outlet from the accelerator well, the pump arm must be disconnected as in Fig. 3.

One of the most common causes of lost power and wasted gas is accumulated formations of sludge and carbon in a motor that is not being operated fast enough, far enough, or hot enough to burn them away. Changing the oil filter more frequently than is recommended for normal driving conditions will help to avoid sludge and carbon formations. A filter that is capable of picking up all sludge and foreign matter

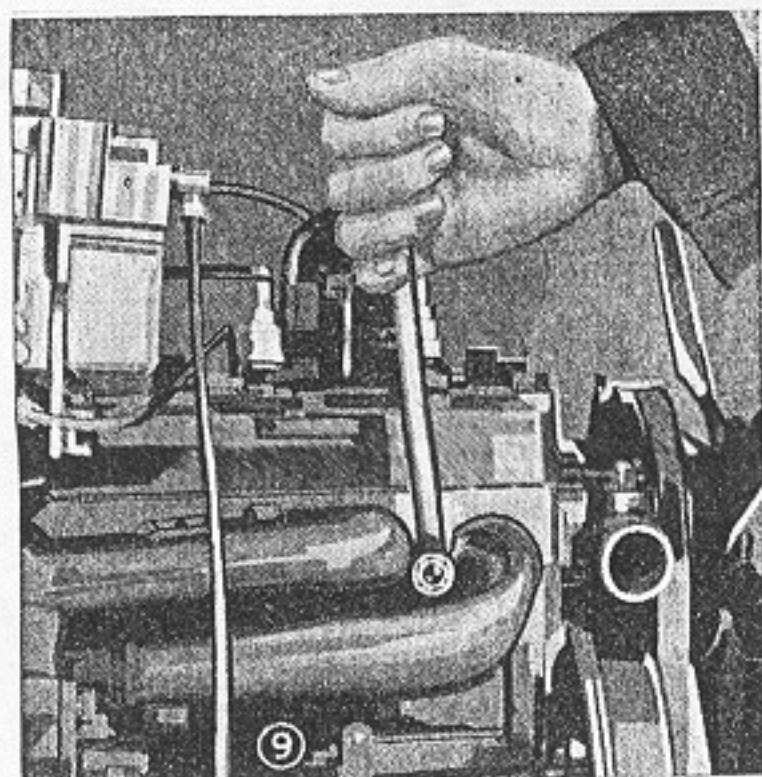


radiator and motor block being done separately and in the direction opposite to the direction that water circulates in the system as indicated in Figs. 6 and 7. Fig. 5 shows what happens when rust, dirt and grease are allowed to accumulate and harden in the motor block.

The thermostat in the cooling system indirectly affects gas consumption. Its function is to make the motor reach operating temperature as quickly as possible and keep it there. The thermostat does this by preventing circulation of water through the radiator until motor-operating temperature is reached, and thereafter controlling the amount of water that passes into the radiator. A simple check for the thermostat is to feel the block as the motor warms up. Heat should be noticed first at the rear of the block and then at the front as in Fig. 8. However, there should be no indication of heat in the radiator until the block has become reasonably hot. If the radiator warms up at the same time as the rear portion of the motor, the thermostat is faulty. Also, if the radiator shows no sign of warming up even after the block has become hot, the thermostat is not operating, necessitating replacement.

Be sure to keep the motor in good condition so that there will be no necessity for using an excessively rich fuel mixture, as for instance, when air leaks through a loose manifold, Fig. 9, between a carburetor and the base on which it is mounted or along the throttle shaft. These conditions necessitate a rich mixture to keep the motor from dying at slow speed. In such cases repairs should be made so that the carburetor can be adjusted to conserve gasoline. Similarly, worn intake-valve guides are gas wasters. Air enters around the guides, Fig. 11, making it necessary to enrich the fuel mixture. To make matters worse, oil is drawn up around the guides, resulting in excessive carbon formations inside the motor as well as a waste of oil. Carbon reduces the size of combustion chambers and restricts exhaust-gas passages, with the result that there is exces-

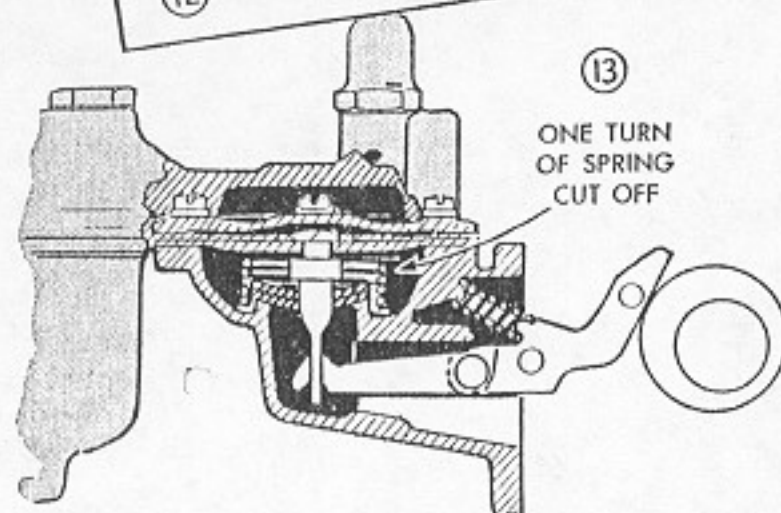
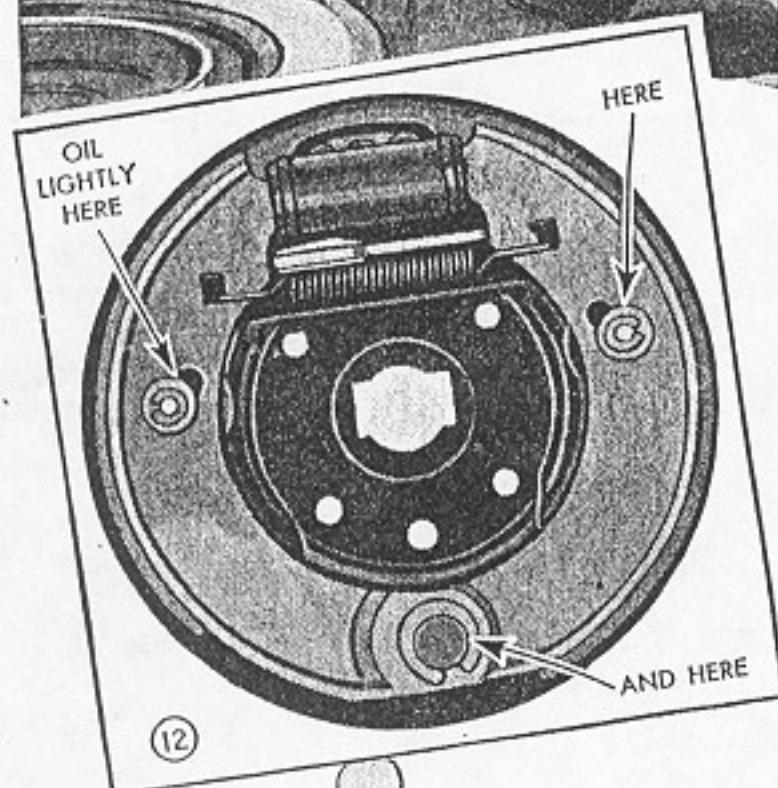
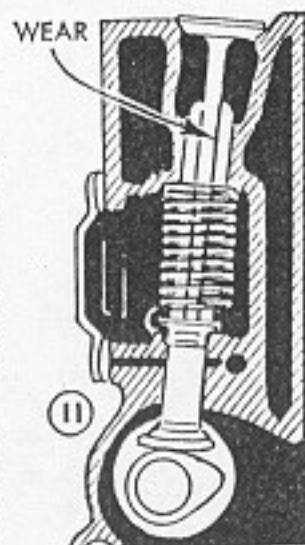
will, in addition to reducing engine wear, help to keep the piston rings free in their grooves. When rings stick, considerable gasoline is wasted through "blowby"—gases from the fuel charge passing between the rings and cylinder walls. However, "blowby" may be caused also by the cooling system. Unless this functions correctly, some cylinders may become hotter than others, or the temperature may vary at different locations on the same cylinder. This results in unequal expansion of the metal with consequent rapid wear on the cylinder walls and piston rings, which in turn causes "blowby." The cooling system should be flushed at least twice a year; the



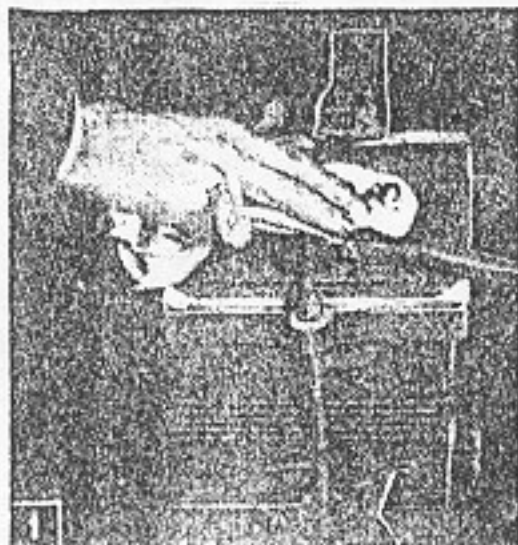
sive fuel consumption. This is especially true when the carbon accumulations are in the muffler, tail and exhaust pipes as it is impossible to burn fuel economically in a motor where there is back pressure due to a clogged exhaust pipe.

One of the most deceptive causes of lost power, with its resulting fuel waste, is a slipping clutch. A test for this is to drive at 20 m.p.h., then apply the brakes while the accelerator is pressed down. A clutch that holds will slow down the motor as the brakes are applied. Both the clutch pedal and brake pedal should have a free travel of an inch or so; otherwise the clutch may slip or the brakes may drag. It is good practice to remove the brake drums at least once a year and lubricate the moving parts of the brakes as shown in Figs. 10 and 12. And, in connection with the chassis, don't overlook heavy oil in the transmission and differential. Under present-day low speed and mileage, you can safely use light lubricants and thus reduce the lubricant drag on the motor to a minimum.

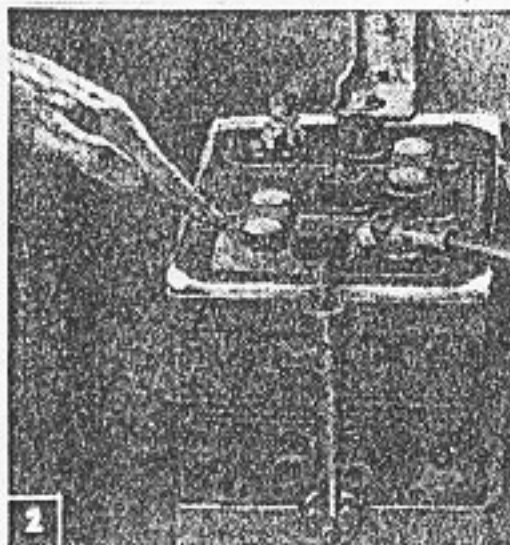
As a fuel pump is designed for general operation through the entire speed range of the car, it is possible to effect a gas saving by altering the pump when the car is driven at 35 m.p.h. or less. On examining the pump, you will notice that the fuel chamber is loaded by direct force of the cam shaft, but that delivery of gasoline to the carburetor is dependent on a spring pressure against the pump diaphragm. By removing one turn from the spring, as in-



indicated in Fig. 13, fuel pressure is reduced slightly to a point where the gasoline does not surge but will flow with less force into the carburetor. It is this surging of the fuel into the carburetor that causes a sudden rise in float-chamber level, which in turn results in a rich mixture.



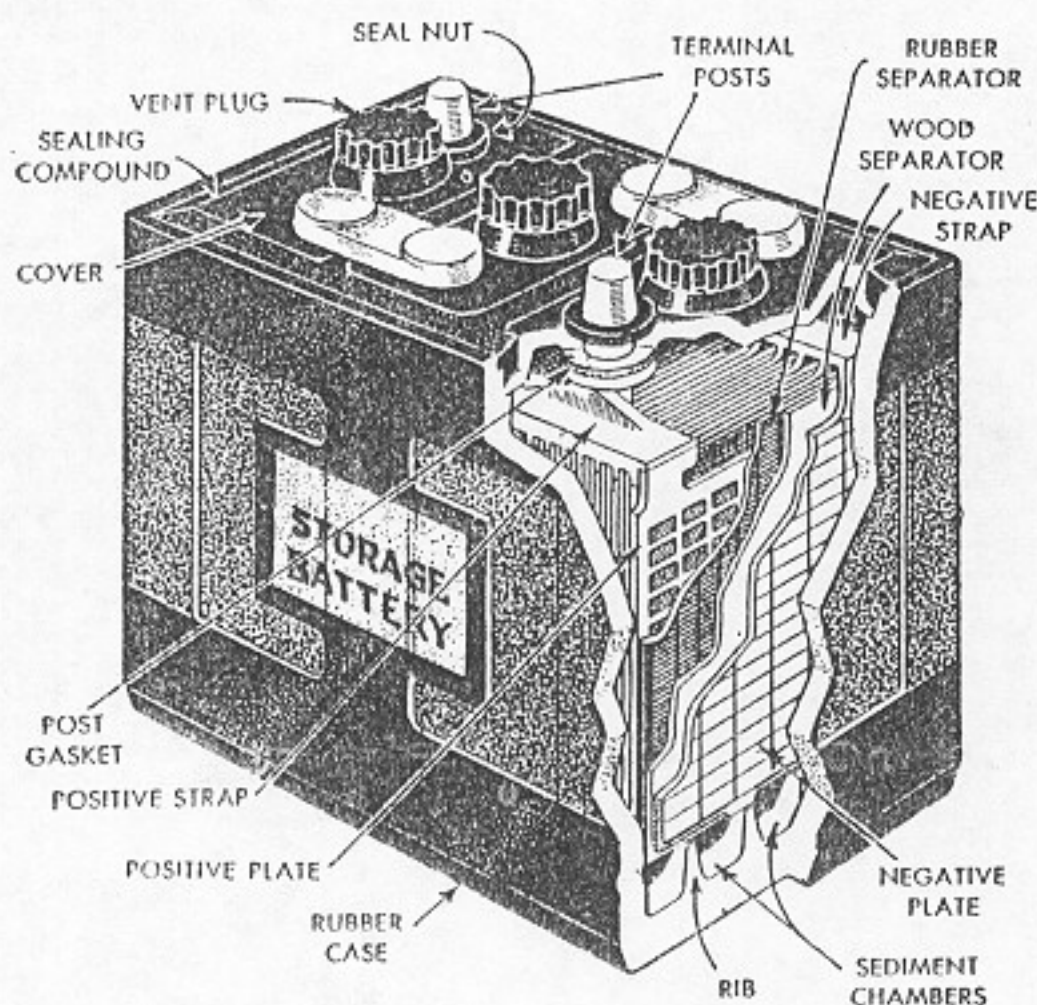
Remove white coating from battery terminals with a soda-and-water solution. Wipe dry with clean cloth



Check sealing compound for cracks. Repair with compound, using in a tarry consistency that does not run



Inspect the battery cradle for acid damage. If the cradle is in poor condition it should be replaced



BATTERY

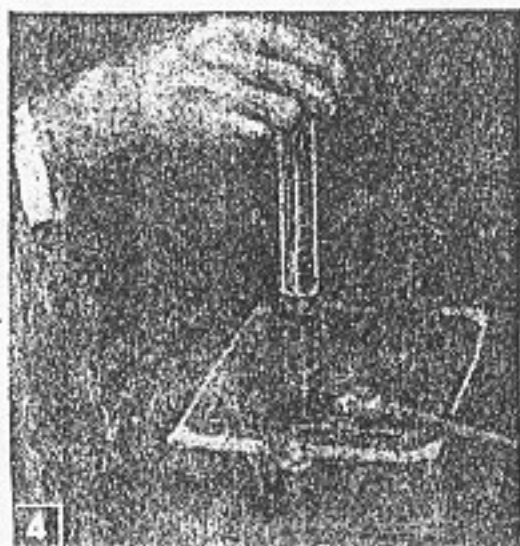
BEFORE one attempts to service any mechanical or electrical device it's a good idea to know how it works. Being well acquainted with your car battery helps you to service it regularly.

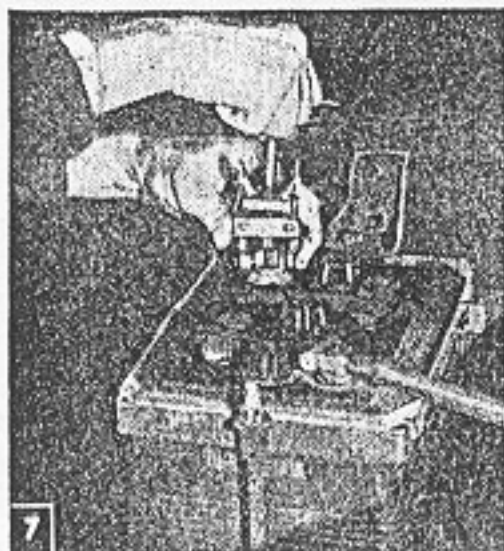
A storage battery consists of three identical 2-volt cells connected in series, making a total of 6 volts across the terminals. Each cell has positive plates of lead peroxide and negative plates of lead, the number of plates depending upon the ampere-hour rating of the battery. An electrolyte solution of distilled water and sulphuric acid sur-

State of the charge is checked with a hydrometer. Reading should never go below recommended levels

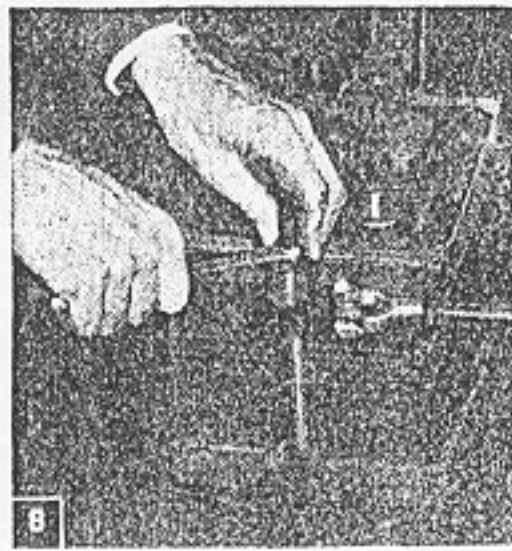
Add water when necessary. In cold weather add water just before driving car, otherwise it may freeze

Before removing the cables from an old battery, note and, if necessary, mark positive terminal





7 Disconnect ground terminal first. Use a puller and work carefully if clamp is "frozen" to the post



8 When replacing battery, tighten bolts uniformly. Renew rubber washers. Don't draw nuts too tightly



9 Worn or frayed cable should be replaced. Note bends in old cable and install new one in the same way

CARE

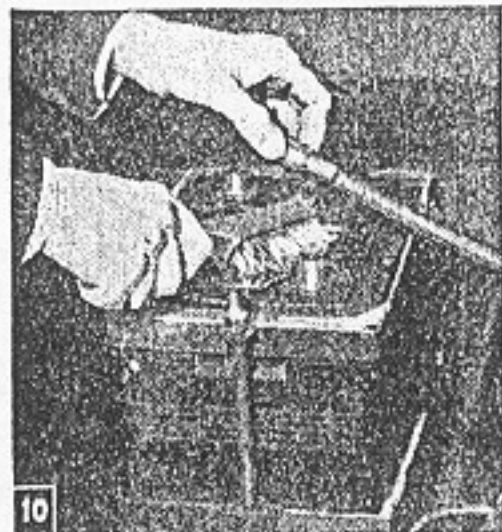
rounds the plates. In order to keep positive and negative plates from touching each other and shorting the battery, nonconducting separators are placed between each pair of plates. In addition, some batteries have Fiberglas sheets to retard the loss of active material from the plate grids. The case is of hard rubber with a space in the bottom for sludge deposits and the cover is a separate piece held in place by sealing compound.

The plates are not solid, but consist of a framework or grid composed of an alloy of lead and antimony. The mesh of the positive plate is filled with lead peroxide and that of the negative plate with sponge lead. These fillers are porous to allow the electrolyte to penetrate them freely. When the battery is in use, lead peroxide and sponge lead gradually drop off the grids and fall to the bottom of the battery case. The speed with which this happens depends upon how nearly the battery charge is kept normal, how it is charged and how used. To get the

most out of a battery, the active material must be kept on the grid or framework as long as possible, the separators must be kept in good condition and the case protected from damage and leakage.

When the electrical circuit is closed between the positive and negative terminals of the battery, as when the lights are turned on or the car is started, the sulphuric acid in the electrolyte combines with the material on the plates, both negative and positive, to form lead sulphate. Electric current then flows through the electrolyte to the positive terminal and out to the electrical system. As this happens, the amount of acid in the battery solution decreases. This action gives the basis of testing battery strength with a hydrometer, which measures the amount of acid in the solution in proportion to the water present, by the difference in the specific gravity of these two liquids. There is no change in volume of liquid in the battery, as the absorbed acid is replaced by water in the

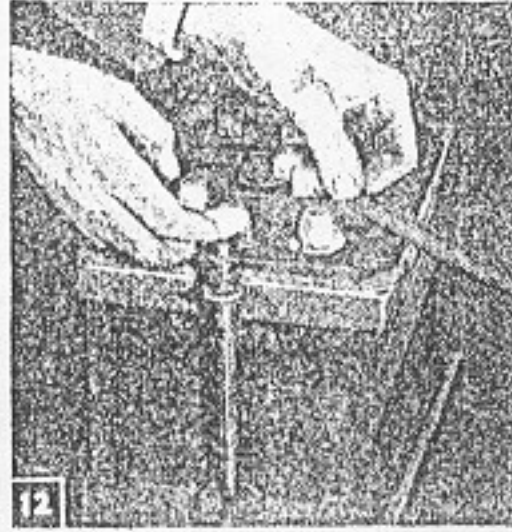
Clean and brighten terminal posts with a wire brush. Be careful not to get dirt into the cell-cap vents

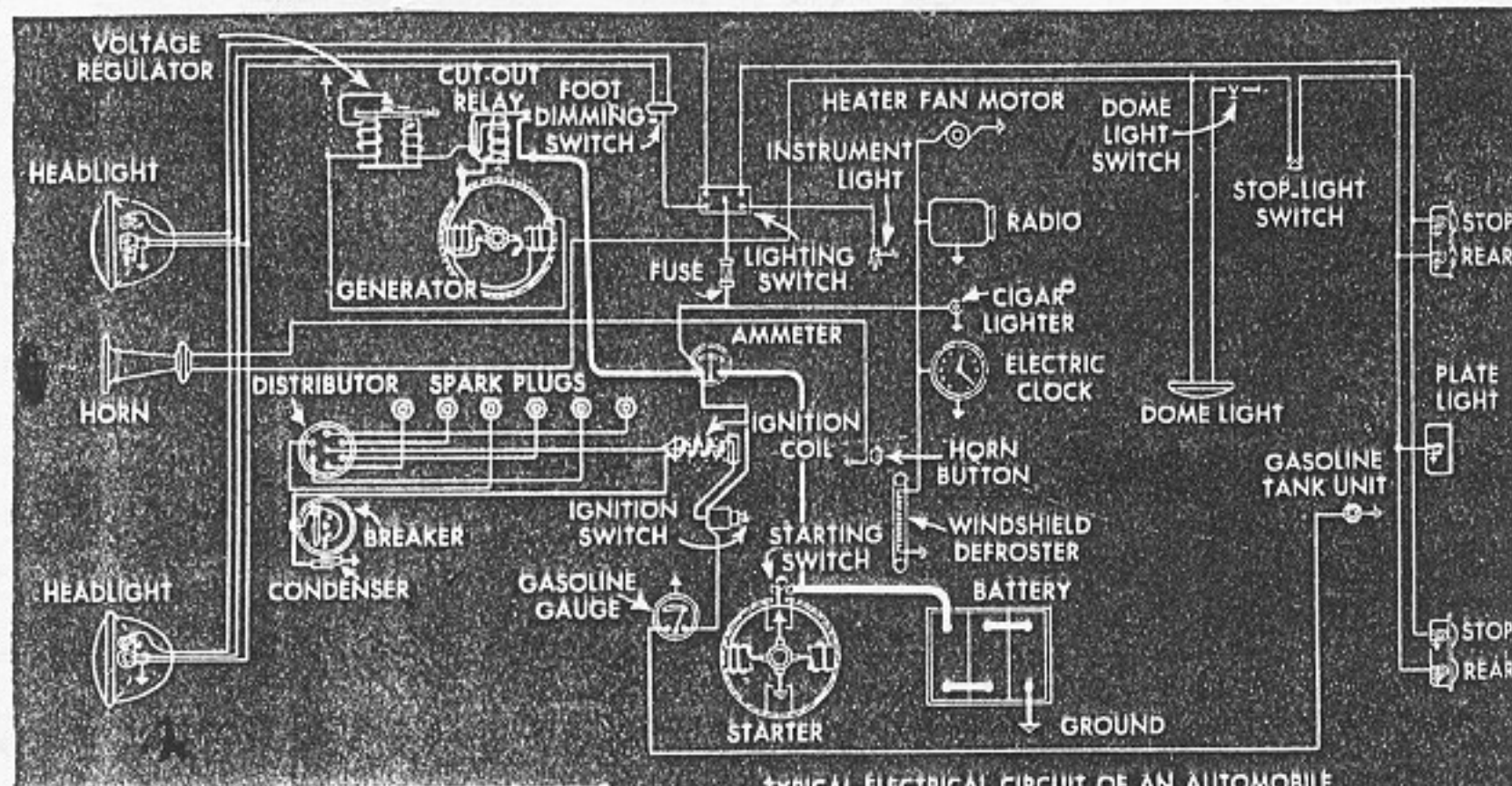


Clean inside of terminal clamps with sandpaper. Grit in the clamp slot will interfere with tightening



Apply mineral grease or white petroleum jelly to battery posts and terminal clamps. Cover thoroughly





TYPICAL ELECTRICAL CIRCUIT OF AN AUTOMOBILE

Courtesy The Electric Storage Battery Co.

TABLE A
CURRENT LOAD OF A MODERN CAR

HEADLIGHTS.....	14.0 AMPS.
IGNITION.....	1.7 AMPS.
INSTRUMENT LIGHTS.....	0.8 AMPS.
TAILLIGHTS.....	1.2 AMPS.
LICENSE LIGHT.....	0.6 AMPS.
HEATER AND DEFROSTER.....	7.0 AMPS.
RADIO.....	7.5 AMPS.
	32.8 AMPS.

SUMMER STARTING 125 TO 300 AMPS.*

WINTER STARTING 300 TO 700 AMPS.*

*Varies with engine size and oil viscosity

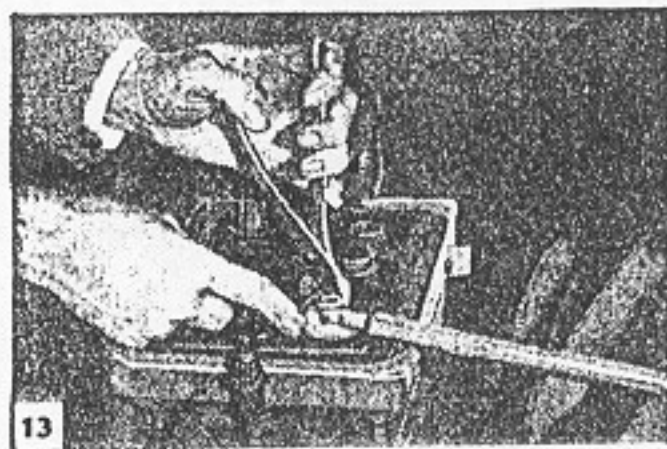
Take a minute to study this typical wiring diagram and you'll have a better idea of the heavy load on your car battery

chemical process. A fully discharged battery contains nothing but water, with the acid completely absorbed in the plates as lead sulphate.

Charging simply reverses this process, and by this means the battery can be restored to full charge, provided the lead sulphate has not been allowed to remain on the plates too long. When it is impossible to recharge a run-down battery, it's usually because the plates have remained sulphated too long, or the active material has dropped off the plates.

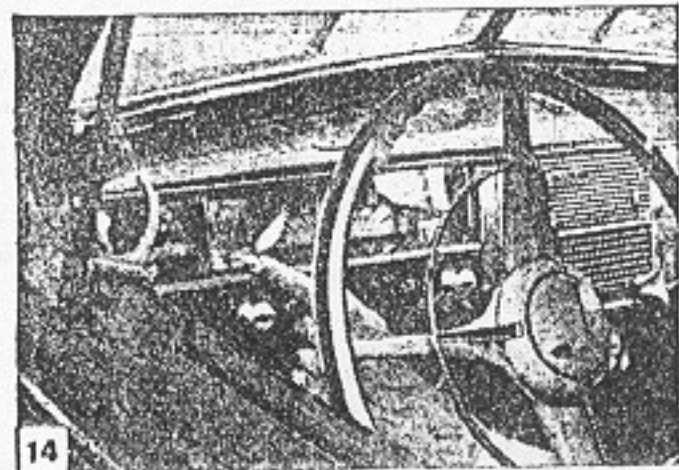
When you buy a battery rated at 100 ampere-hours, this theoretical rating means that the battery will deliver 100 amperes of current for one hour, or one ampere for 100 hours. Normally, careful testing and charging of a battery is a job for a fully equipped service station, but a hydrometer to test the strength of the electrolyte is inexpensive to own and easy to use. Make a test only when the battery solution is thoroughly mixed, never immediately after adding water. Hydrometer readings are set for one temperature, usually about 80 deg. F. A temperature correction of "4 points" of gravity must be made for each 10 deg. of variation from 80 deg. F. Add for above 80 deg. and subtract for below 80 deg. For example, the gravity of a fully charged battery, at 80 deg. F., is 1.280. At 100 deg. F., it will be about 1.288. At 10 deg. F., it will be 1.252. These are battery-solution temperatures, not air temperatures.

Figs. 1 to 14 picture the steps necessary in ordinary periodic care of a battery. Table A lists the average current requirements of a modern car with the usual accessories and the detail directly above table A shows a typical wiring diagram.

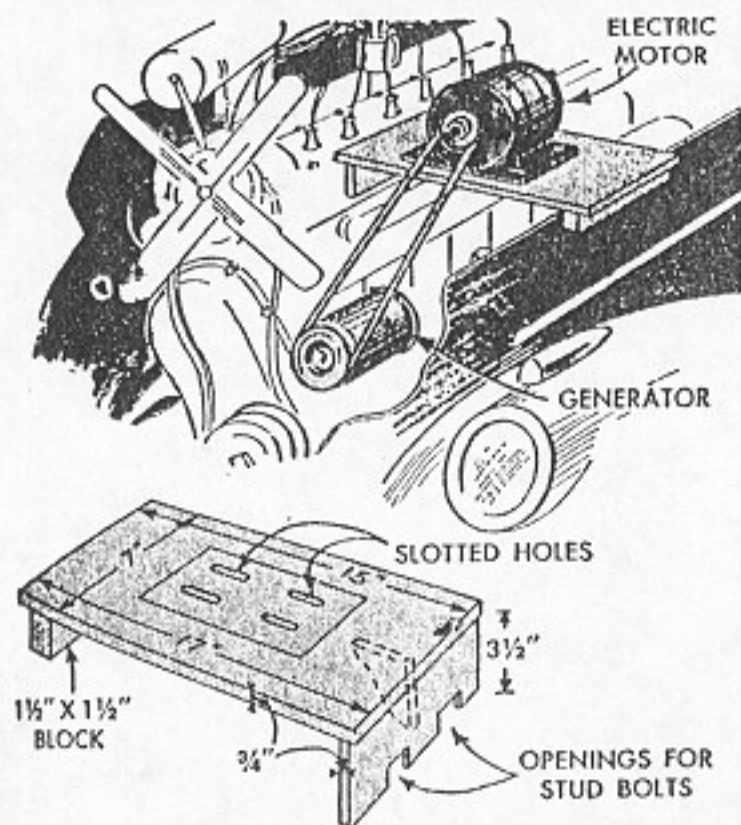


Photos Courtesy Auto-Lite Battery Corp.

Above, tighten clamp nuts with battery pliers. Make sure that the clamp is pressed down on the post as far as it will go. Below, ammeter should read discharge when light switch is on



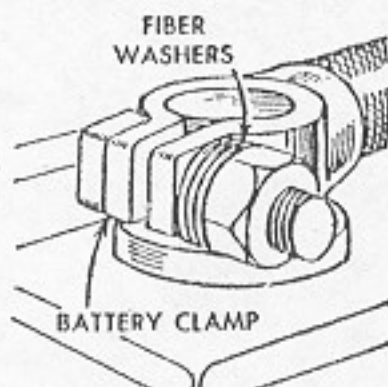
Electric Motor Mounted on Board Recharges Auto Battery



To keep an auto battery charged, a small electric motor belted to the car generator can be installed in a few minutes. The motor must rotate in the same direction as the generator, and is mounted on a board long enough to extend from the engine to one side of the hood. The board is slotted for motor mounting bolts and provided with end cleats high enough to keep it level when in use. It may be necessary to notch the end cleat resting on the engine block to fit over studs; however, installation will vary on cars of different design. To use the unit, remove the fan belt and slip the drive belt over the generator pulley to connect it to the motor. Correct tension is obtained by adjustment of the mounting bolts. In no case should the motor be used on automobiles not having current and voltage regulators unless the battery is watched closely for overcharging.

Washers Prevent Clamp Sticking

If fiber washers are inserted between the nut and clamp when connecting the cable to a battery terminal, the cable will be easier to remove later. Corrosion tends to make the nut stick to the clamp but the washers will prevent this. When the battery is removed, the washers are pried outward to loosen the clamp. It may be necessary to use a longer bolt and acid resistant washers.



Ammonia Frees Battery Terminal

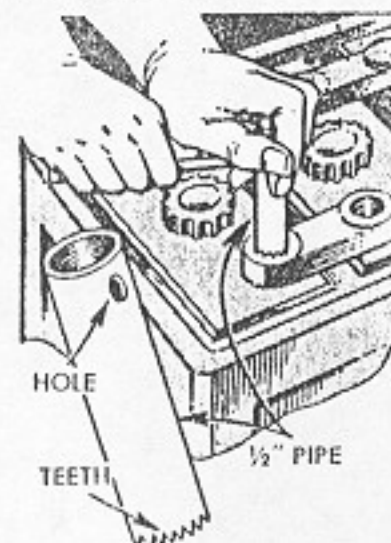
For removing corroded battery terminals that are stuck tightly to the post, apply a small amount of ordinary household ammonia, letting it soak in for a few minutes. The terminal then can be lifted off easily, after which it should be wiped clean and dry.

Extending Auto-Battery Life

Automobile-battery life can be extended considerably if the battery is cleaned and refinished every six months. Remove the battery from the car and plug the small vents in the caps with match stems. Then thoroughly wash the entire casing. If corrosion is difficult to remove, use a soda-water solution to clean it. After this cleaning, any small cracks such as those frequently caused by overtightening of the mounting bolts will be discernible. Mend them by applying a soldering iron to the cracked area until sufficient melting of the hard-rubber casing occurs to fill the crack. Finally, coat the casing with rubber paint of the type used on tires. The battery will look like new and unnecessary damage by corrosion to both the battery and battery cables will be avoided.

Cutter Removes Battery Straps Without Damaging Elements

Instead of sawing off the posts to remove the connecting straps of a storage battery, use a hole saw to cut the strap from the post. To make the saw, file teeth in one end of a piece of thin-wall pipe or tubing and drill a hole at the other end for a handle. To use, press the cutter down on the strap where it fits over the terminal post and turn the cutter back and forth until the ring is cut through. The straps can then be lifted off, and may be placed over the posts of a new cell and soldered tight.





LICK COLD-WEATHER STARTING PROBLEMS

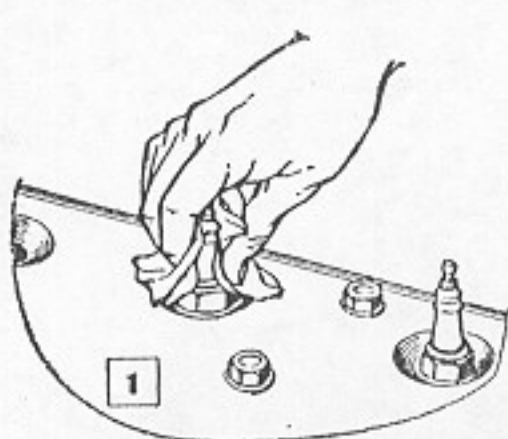
DO YOU step into your car on a cold morning with a doubt in your mind that the motor will start? It will if it is in good mechanical condition. And good mechanical condition does not necessarily refer to a new car. Unless your car has already passed the 50,000-mile mark, the chances are that a few simple checks of the fuel and ignition systems, to bring them to peak condition, will enable you to start the "old bus" on the coldest mornings.

Probably the most frequent cause of hard starting in winter is a weak or defective battery. As winter approaches, the load on the car battery increases. Also, as temperature lowers, the efficiency of the battery decreases. As the weather grows colder, careful drivers keep a check on the battery charge with a hydrometer, Fig. 8, and if periodic checks show that the load is steadily decreasing the hydrometer readings below 1.250, the charging rate is increased sufficiently to maintain the full-charge reading,

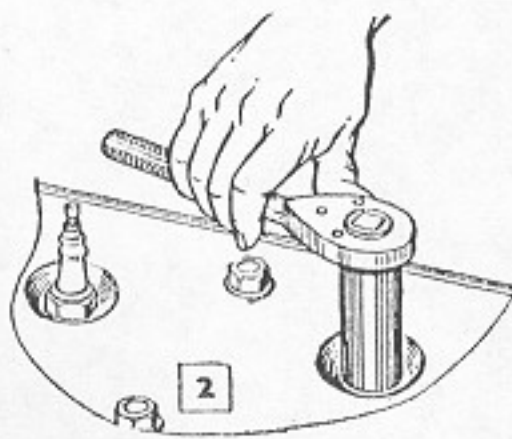
1.250 or slightly higher. Many motorists supplement normal generator charging with a trickle charger connected to the battery overnight. If the battery is more than a year old, it's a good precaution to take a voltmeter reading of each cell at least twice a year. If a defective cell is detected by this test, the battery should be replaced.

Defective or weak-battery symptoms also can be caused by a loose ground connection or badly corroded cable connections. Often it is necessary to make a careful check to be sure that one defect is not mistaken for another. Keeping all battery and ground connections clean and tight will avoid any trouble from this source.

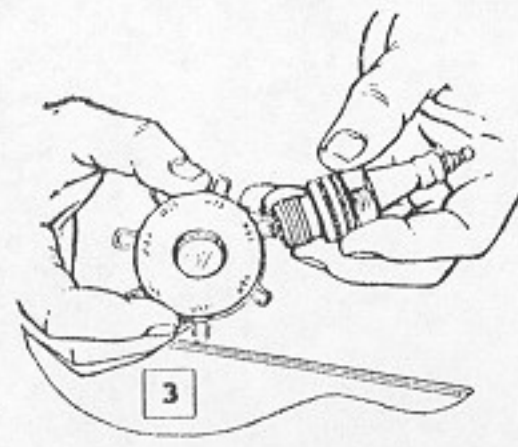
Cars kept in unheated garages frequently give trouble in starting due to wet spark plugs. When the temperature rises after a cold snap the engine "sweats," due to moisture condensation. Moisture coats the plugs and cables and the high-tension current jumps from the



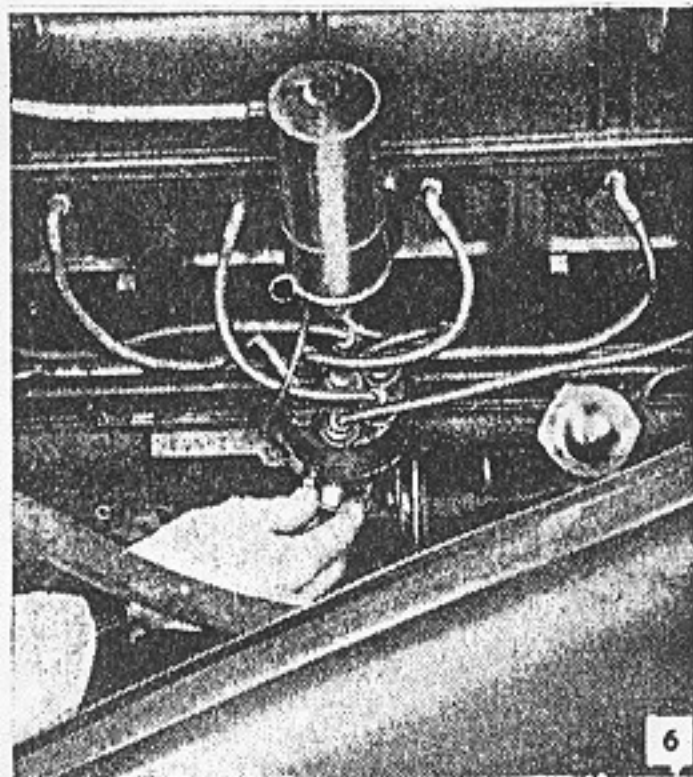
Wipe moisture from spark plugs and cables with a soft, dry cloth



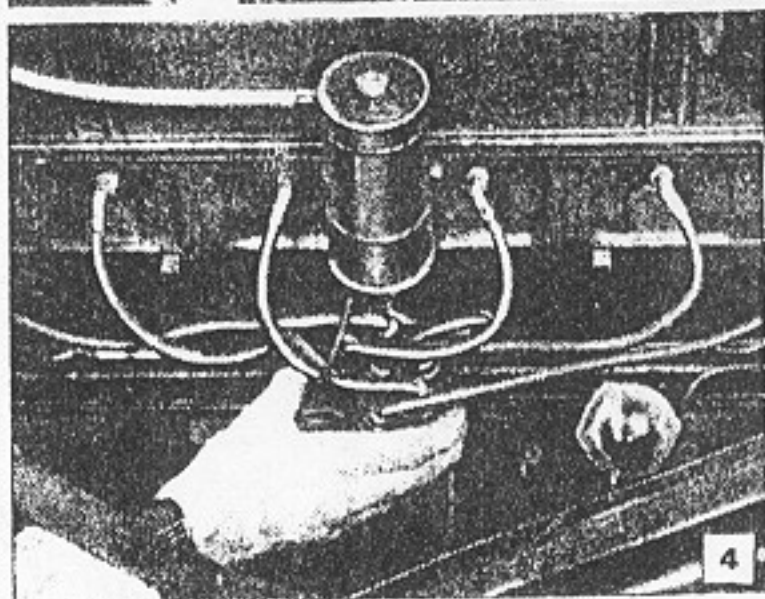
Use a deep-wall socket when tightening spark plugs to avoid breaks



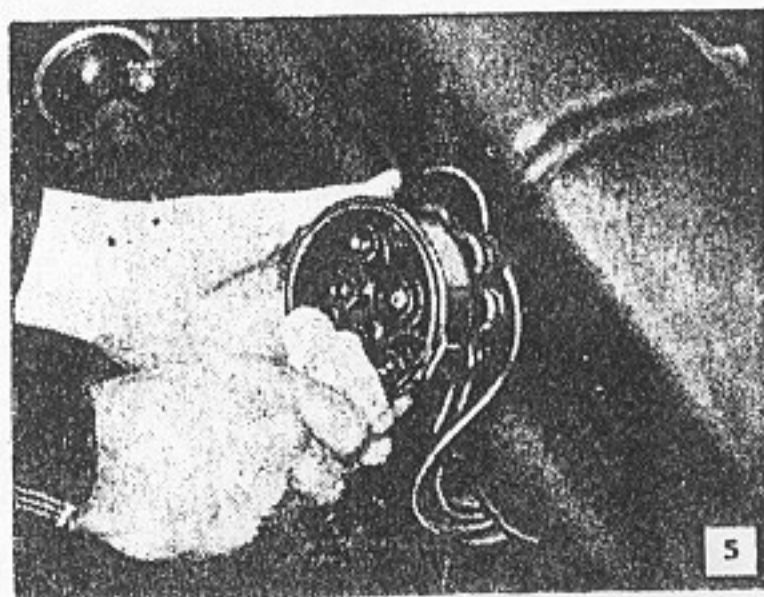
Check the electrode gap with a wire gauge made for the purpose



Overlubricating distributor may force grease into breaker mechanism and foul the points



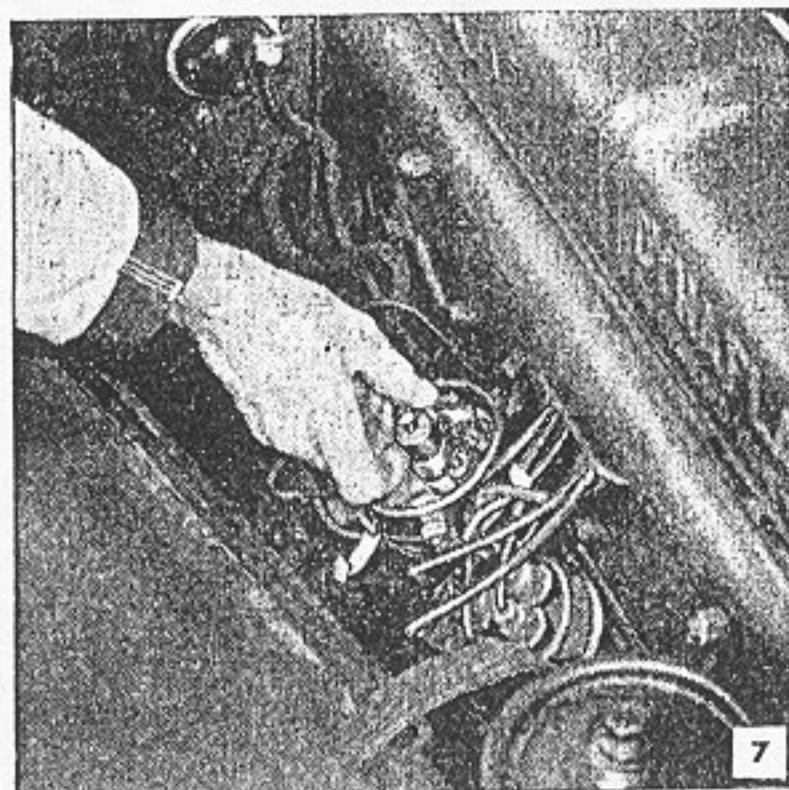
Above, lift the distributor carefully to avoid damaging the gasket. Below, clean the inside of the cap thoroughly with a dry cloth. Examine cap inside and out for cracks. Also check condition of rain guards



plug terminal to the cylinder head, "shorting out" the plug. When this is the cause of failure to start, remove the cables and wipe the plugs and the cables with a dry cloth as in Fig. 1.

Exact gap spacing of the spark-plug electrodes, Fig. 3, is especially important in cold-weather operation of the car. Commonly recommended gap settings range from .025 to .029 in., but there are variations up to .040 in. Wide gaps and irregular gap settings in the same engine are a common cause of hard starting in cold weather. Some manufacturers recommend two settings, one for warm weather and another for cold-weather driving. In adjusting the gap always bend the side electrode and when removing plugs use a special spark-plug wrench or a deep-walled socket as in Fig. 2, to avoid cracking the porcelain. Make it a practice to clean the electrodes with fine sandpaper each time the plugs are removed. As plugs are replaced, always check the gaskets. Any that are scored should be renewed.

Making sure that the battery, battery cables and the spark plugs are in good condition eliminates a number of the common causes of wintertime starting troubles. This leaves the distributor still to be examined. Remove the cap, Fig. 4, and wipe the inside with a clean cloth, Fig. 5. Examine the cap carefully for cracks and indications of arcing. Unless the distributor is kept in good order by frequent cleaning and inspection, there is a tendency in some types of distributors for a dirt track to form inside the cap where the rotor contact travels. Here, fine dust, moisture and oil combine to form a heavy, sticky coating which in time will cause arcing, burn-

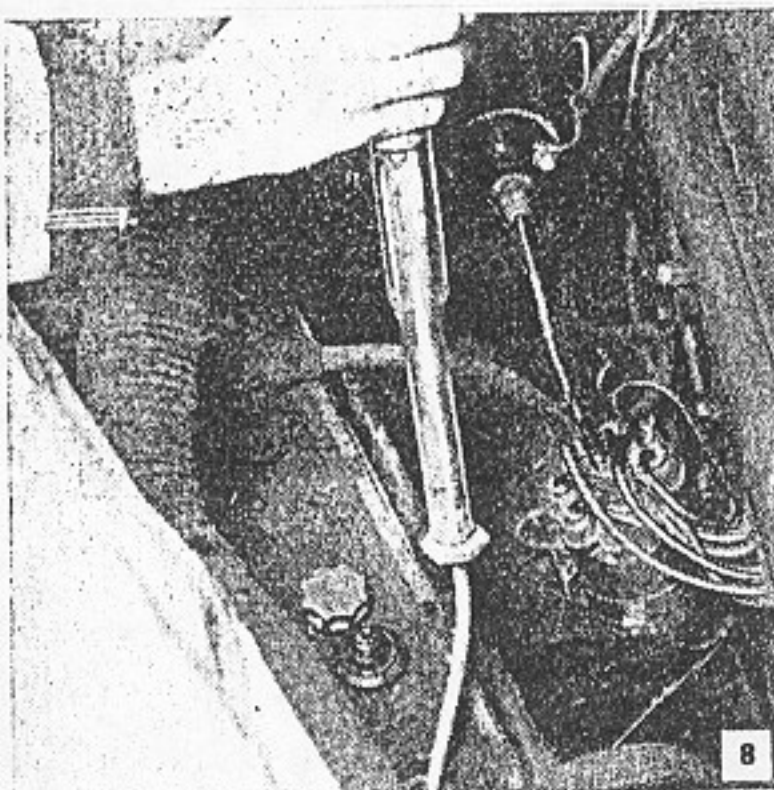


Remove rotor by pulling it off the driving shaft. When replacing be sure that it is properly positioned

ing and even cracking of the cap. Examine the top of the cap particularly for cracks. Be sure the spark-plug cables and the center cable from the coil make good electrical contact inside the socket terminals. Also be sure the rain guards over the cables fit tightly and have no cracks or wide breaks. Condition of the guards is especially important to good winter performance as they prevent moisture or a water splash from entering the distributor and suddenly "drowning" the ignition system.

Next, lift the rotor, Fig. 7, and examine the breaker mechanism. If the points are burned and deeply pitted so that they make only a partial contact, the parts should be renewed; also the condenser, which is a likely source of this trouble. On the other hand, if the parts seem to be in reasonably good condition, the points can be dressed to a true contact with a breaker-point file. The specified breaker-point gap ranges from .018 to .022 in. Check with a thickness gauge and set the gap according to the manufacturer's instructions. After setting the gap be sure the eccentric screw is tightened to hold the adjustment. Avoid overlubrication of the distributor shaft. Give the grease cup a turn or two after each 1000 miles, Fig. 6.

Automatic chokes generally have a winter and summer setting, which makes it possible to vary the richness of the starting mixture of fuel, and some are fitted with a fast-idle mechanism that simplifies starting a cold engine and gives better control during the warm-up period. The choke is operated automatically by a thermostatic control so located that it is actuated by changes in manifold temperature. Where the choke-control system includes a fast-



Hydrometer readings of 1.250 or above normally indicate full battery charge. Check cells with voltmeter

idle control, the thermostat actuates not only the choke valve but also a vacuum valve or piston which measures the idling fuel mixture. As soon as the engine reaches normal operating temperature, the choke becomes inoperative, but as the engine cools after operation, all parts of the choke mechanism return to the starting position. By carefully following the manufacturer's directions for setting, anyone can adjust the automatic choke. On older cars equipped with manually operated chokes, correct operation depends on the skill of the driver. Overchoking will flood the engine and make it difficult if not impossible to start. Flooding also will dilute the crankcase oil with unburned fuel, which passes the pistons. Running with the engine partially choked also can result in rapid wear of cylinder walls and piston rings as the raw fuel washes away oil which normally reaches the upper part of the cylinders. Ordinarily, the trick in operating the manual choke is to synchronize operation of the choke with that of the starter so that a rich fuel mixture is drawn into each of the cylinders on the first intake stroke. After the engine starts, the choke is closed by stages until the engine has reached operating temperature.

Poor compression due to leaky valves or worn rings causes hard starting any time. Such an engine needs both a valve and ring job to put it in proper condition for winter service. If poor compression is the cause of hard starting, an instrument check of the engine will show what parts are at fault. Sometimes a defective head gasket or possibly spark-plug gaskets are the cause of poor compression. These parts are quite commonly at fault in older cars.

OIL CHANGES

EVERY MOTORIST is faced with this question which becomes more and more perplexing as he hears many recommendations. Some tell him to change oil every 1000 miles, others recommend 2000 miles, and still others advocate changing oil every 3000 to 5000 miles, most recommendations being dependent on favorable or unfavorable driving conditions.

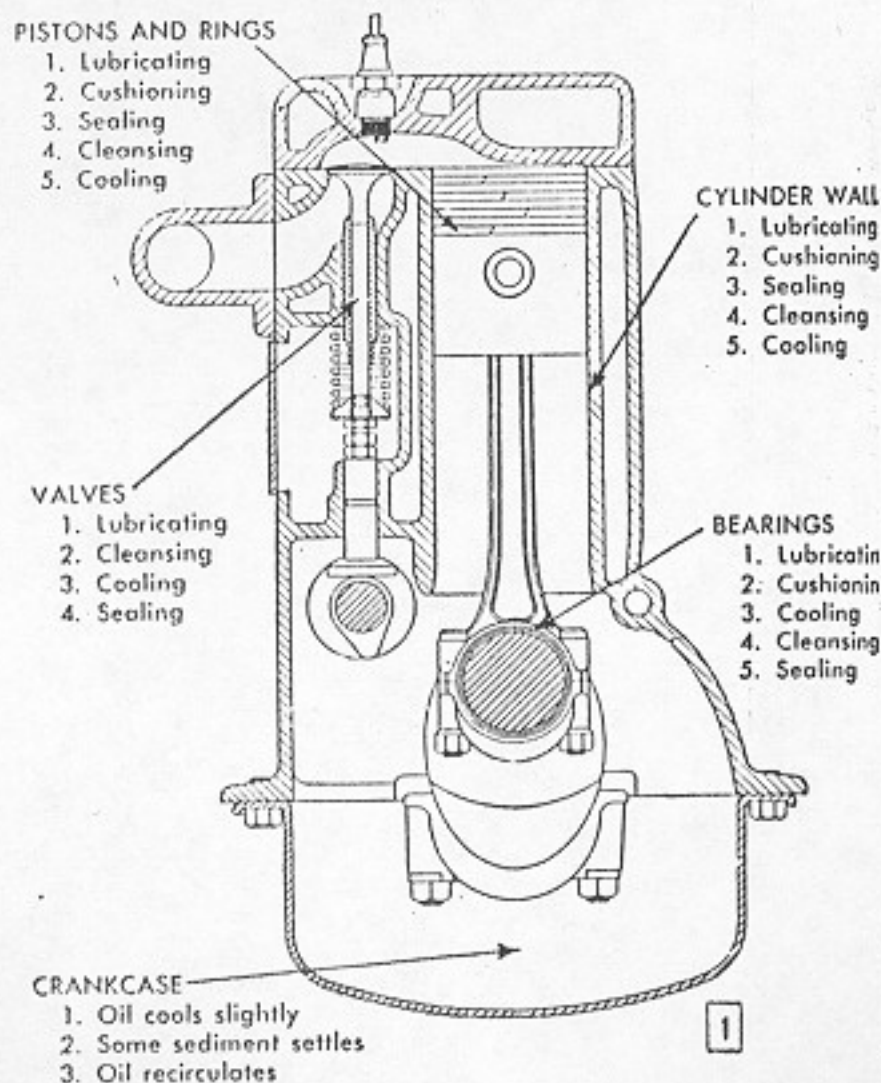
In order for a motorist to determine which of these many recommendations is best suited to his particular car, it is necessary that he understand just what oil does for his engine and how driving conditions affect it. Reference to Fig. 1 will give some idea of what oil does for the engine, and Fig. 2 shows the maze of passages through which oil must travel to correctly lubricate an engine. From these two views, you can readily understand the importance of correct lubrication.

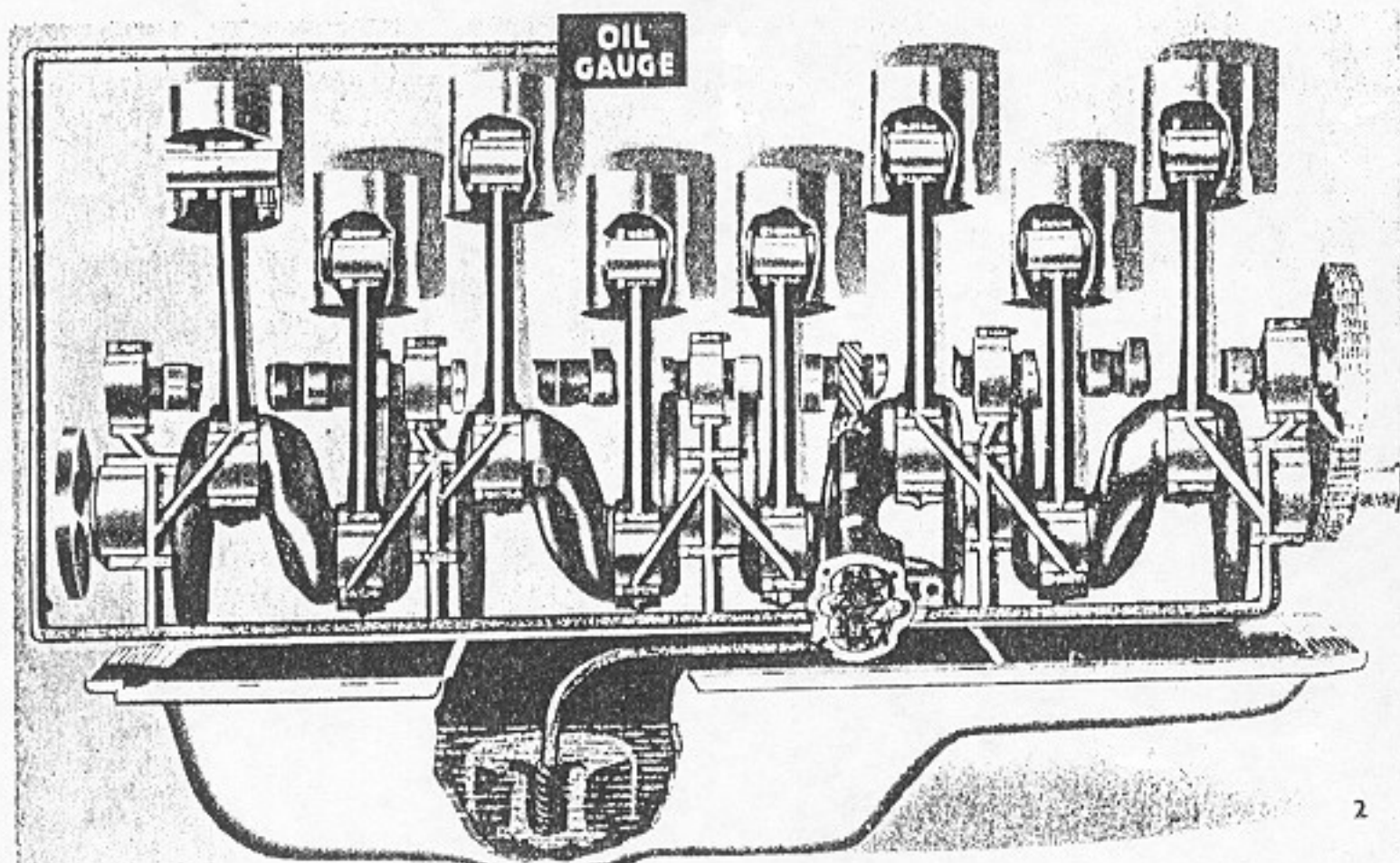
In order to determine when oil should be changed to be reasonably sure of correct lubrication, it is necessary to know how driving conditions affect it, as the way a car is driven has more to do with frequency of oil change than any other one factor. As an example, many long-haul truck fleets operate with oil drains at intervals from 3000 to as high as 7500 miles with completely satisfactory results in spite of the fact that such vehicles travel at high speeds with heavy loads. On the other hand, passenger cars, which are operated with a great deal of starting, stopping and idling, require oil drains more often to avoid excessive oil deterioration, sludge deposits, etc.

Contrary to the popular impression that high-speed engine operation under heavy loads in hot weather imposes the severest conditions on motor oil, this type of operation is the



WHAT YOUR OIL DOES





most favorable when oils of good quality are used. The worst driving conditions on oil are those involving short periods of running, and frequent stopping, starting and idling, under which the majority of passenger cars are used.

Only two things can cause deterioration of motor oil to the point where it becomes unsatisfactory as an engine lubricant. These are oxidation, caused by extended use at very high temperatures within the engine, and contamination.

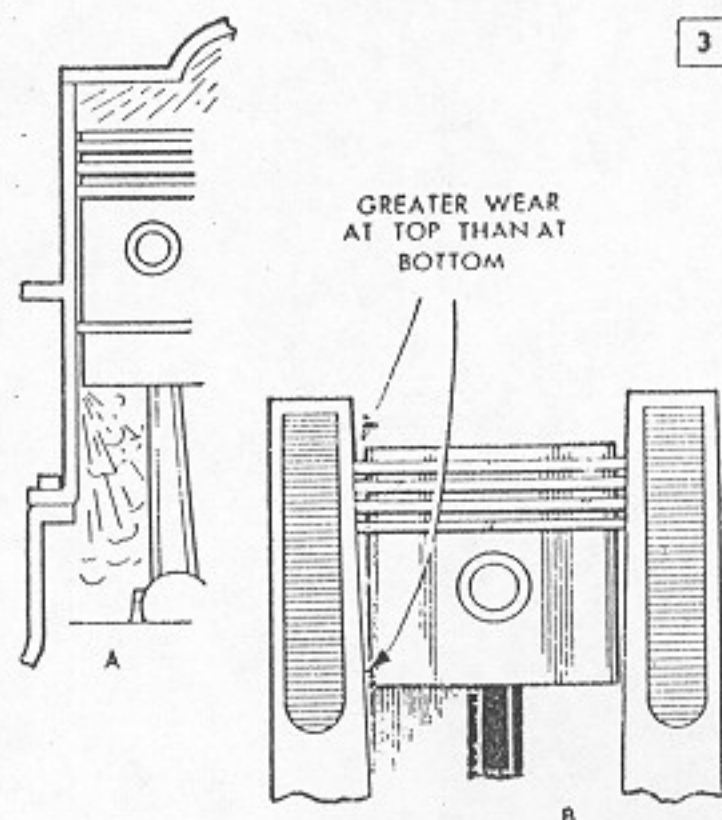
When motor oils are subjected to very high temperatures for extended periods

Diagram above graphically shows the path oil follows in reaching such vital engine parts as pistons, rings, cylinder walls, bearings and valves

they tend to oxidize. Unstable oils of poor quality, on exposure to such conditions, will form sludges, varnishes and corrosive acids, which may cause stuck valves or rings, plugged oil lines and screens, and burned or corroded bearings.

The most important and most frequently encountered cause of oil deterioration is contamination. When engines are used in light service, engine-jacket and crankcase temperatures do not get high enough to maintain good lubrication. Contrary to popular opinion, a hot-running engine is more efficient, is subject to less wear and is easier to lubricate than a cold-running engine used in light intermittent service. In the latter engine, cool cylinder walls act as condensers of fuel vapors and combustion products, such as combustion soot, moisture and lead compounds from burning antiknock-treated gasoline. These impurities then wash past or blow by the pistons into the crankcase, detail A, Fig. 3, instead of being blown out of the exhaust pipe. In the crankcase these combustion products mix with the oil and cause contamination. When these contaminants reach excessive concentrations they tend to emulsify, coagulate and settle as sludge deposits, Fig. 7.

Experienced lubrication engineers have said frequently, "Good oils don't wear out, but they can be contaminated to death." Frequent oil drains are necessary not because oil wears out, but to flush blowby contaminants from the crankcase before



they build up to dangerous concentrations.

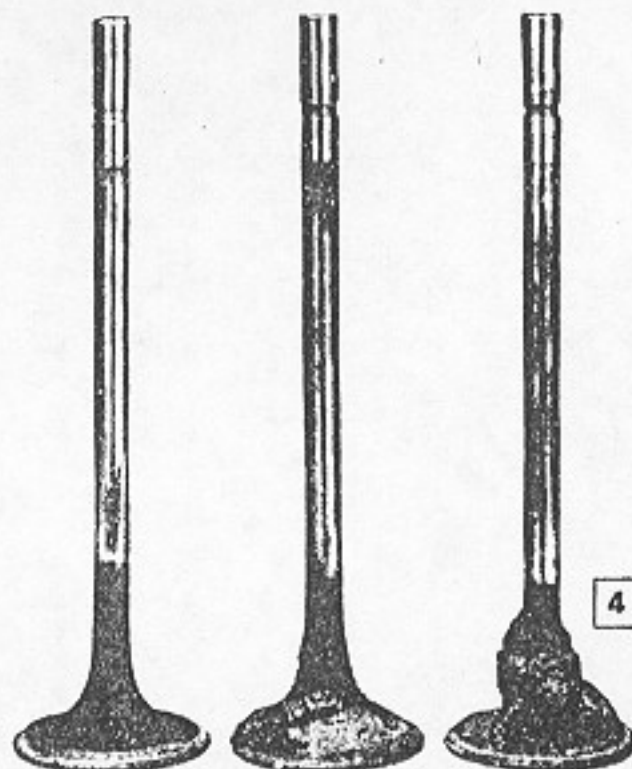
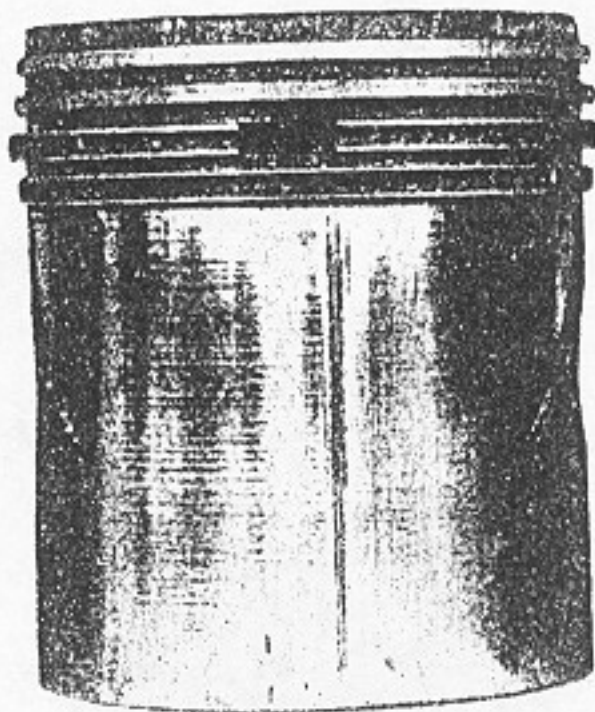
In order to minimize as far as possible excessive blowby contamination of the crankcase oil, engine cooling systems should warm up quickly and maintain coolant temperatures of at least 140 deg. F., and preferably 160 to 180 deg. F. This applies especially to cylinder-jacket temperatures which, when below 140 deg. F., are the starting point of oil contamination.

An important fact is that the dashboard temperature gauges do not give an accurate indication of cylinder-jacket temperatures. These gauges show cylinder-head temperatures, which always are the hottest point of a cooling system, with the result that in cool or cold weather the cylinder and jacket may be much too cool. The best insurance against cold cylinder walls is to be sure the cooling-system thermostat is in good working order, and it is advisable to use a thermostat having a setting of 160 or 170 deg. F.

Adequate crankcase ventilation also is essential to provide purging of volatile blowby products from the crankcase before they condense and mix with the oil.

Rich fuel-air mixtures mean poor combustion, which in turn, means excessive soot formation and raw gasoline dilution in the oil. If your oil thins out badly and turns black in color, you can be pretty sure the carburetor is set too rich, or that the choke is used too much, or that the engine is idled too much. Idling involves the richest mixtures and poorest combustion, and the worst conditions of oil contamination with raw gasoline, moisture, road dust and soot.

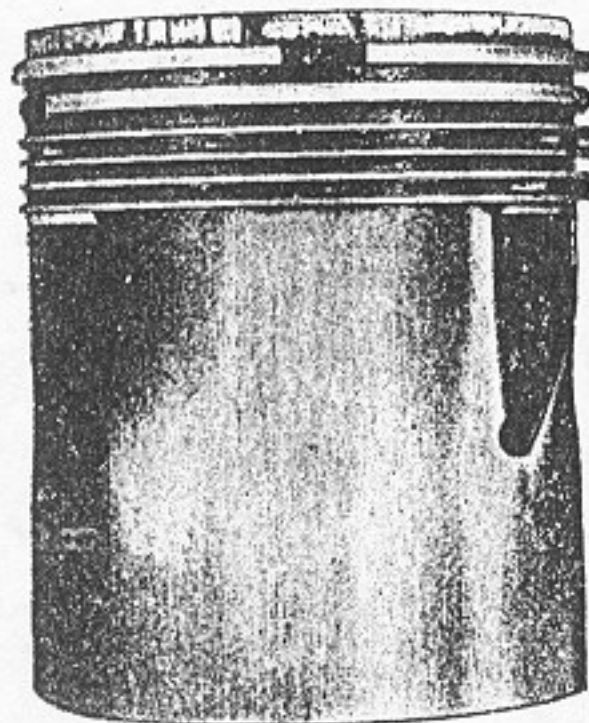
Actual, unretouched photos of good and bad road-test pistons. Scored and fouled piston at left is result of badly contaminated oil due to infrequent changing

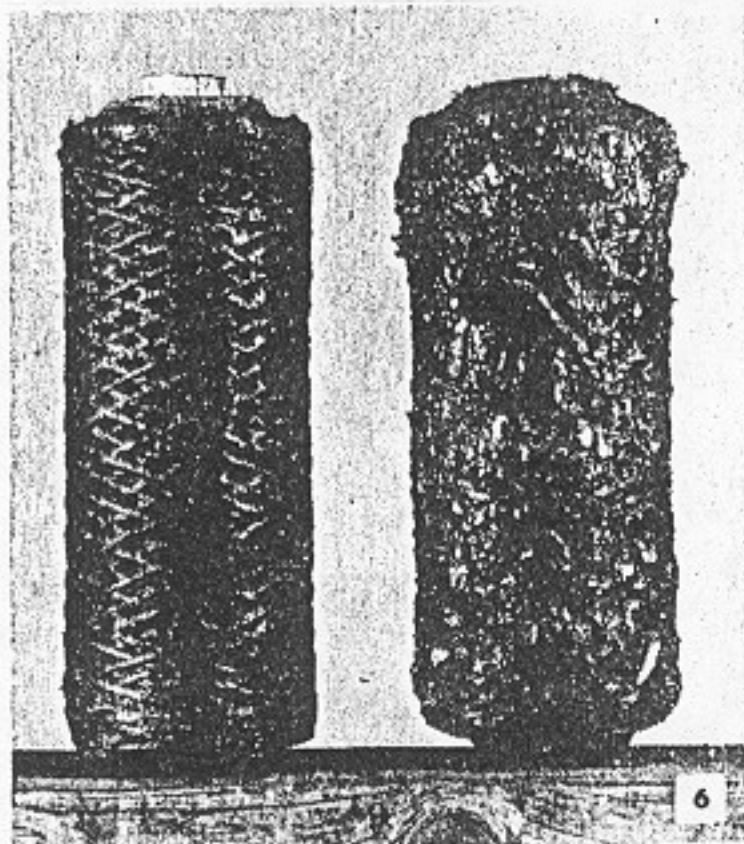


The deposit-free valve at left shows how clean the valves remain when oil is changed regularly. Dirty, fouled valves at right clearly show the difference

Oil filters are of great help in prolonging oil life as well as engine life. Filters remove dirt, insoluble blowby contaminants (not acids) and dust from the oil as it circulates through the engine. However, oil-filter cartridges, just like the crankcase oil itself, must be changed at proper intervals if the filter is to perform its intended function. Cartridges should be checked at each oil change and should be replaced as soon as signs of heavy solid deposits appear on their external surfaces.

The effects of driving conditions on oil contamination and on oil-filter life are illustrated by the photo of two filter cartridges, Fig. 6. The cartridge containing a moderate





Clean oil-filter cartridge pictured at left shows results of 6000 miles under favorable conditions, as compared to sludge-filled one which was driven only 1800 miles under adverse driving conditions

amount of oil sludge was used for 6000 miles on an engine driven under favorable conditions; in this case, high-speed country driving in hot weather. The heavily sludged cartridge was used for only 1800 miles on an engine of the same make, but driven under adverse conditions; entirely stop-and-go city driving in winter and with the engine in poor condition as to carburetion and cooling-system temperature control.

Although a properly maintained oil filter is a wise addition to any engine, filters are not a cure-all and cannot correct the basic problem of oil contamination or the need for periodic oil changes at reasonable mileage. New or rebuilt engines with tight rings and unworn piston, ring and cylinder surfaces develop relatively little

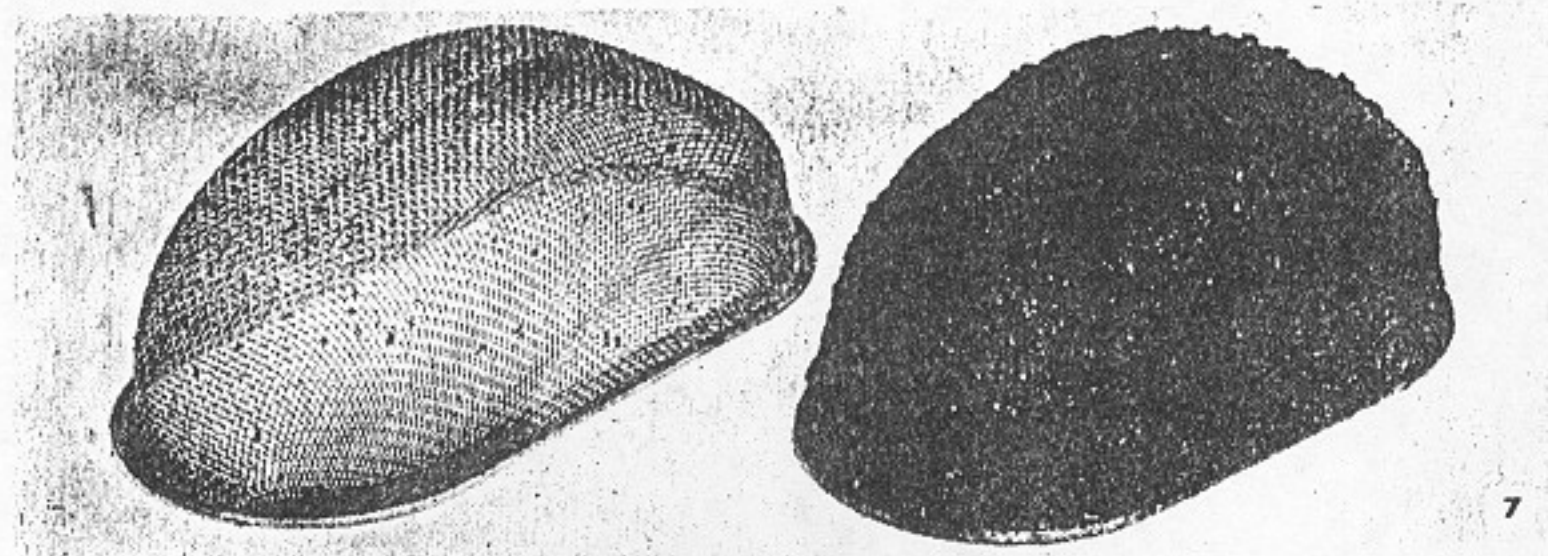
Two similar examples, below, show a clean and a sludge-filled oil-pump screen. Heavily choked one at right has been made completely ineffective by deposit

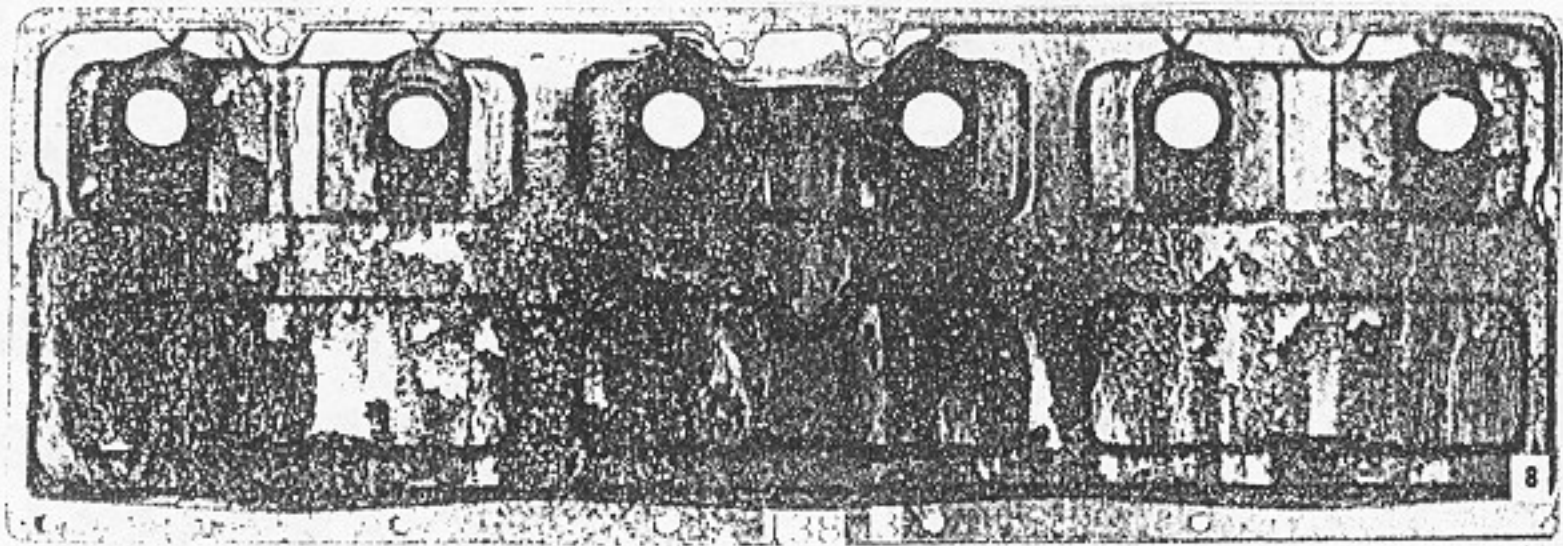
blowby and oil contamination. As engines become older and more worn, the amount of blowby and the rate of oil contamination increase rapidly due to looser fits and larger clearances, as indicated in detail B, Fig. 3. As an engine wears, the cylinders become tapered. This means that as the pistons move up and down, the rings must expand and contract to follow the tapered surface of the wall. At extreme speeds, and when the pistons are fouled with carbon, the rings may not be able to adjust themselves. As a consequence, blowby is greater along with its destructive effect on engine oil. By comparison, therefore, newer engines require less-frequent oil drains than older engines.

Some very interesting practical information has recently been released by a well-known research laboratory. A large-scale field test was conducted to study the relation of oil contamination to oil change periods. Vehicles in this field-test program were divided into three groups: Group 1 adhering to an oil-change interval of 1000 miles; group 2 changing oil at 2500 miles, and group 3 changing oil only every 5000 miles.

Analyses of the used oils drained from the engines in each of these groups showed that the oil drains from the group-2 cars, running with 2500-mile changes, contained from 55 to 65 percent more contaminants than those from the group-1 cars, running with 1000-mile oil changes. The drains from the group-3 vehicles, running with 5000-mile drains, contained from 114 to 174 percent more contaminants than the group-1 cars. When it is considered that these contaminants consist of carbon, soot, oxidized matter, metal particles and compounds, dust, dirt and abrasive matter, there is good reason for not using oil too long. Figs. 4, 5 and 9 give an indication of what can happen inside an engine when oil of a high contamination is used. Valves carbon up and burn, and pistons and bearings score. Fig. 8 shows a valve side cover coated with sludge, and Fig. 10 shows a cover when clean oil is used.

Although many factors govern the mile-





Compared with clean side cover plate below, this sludge-covered one shows what contaminated engine oil will do

age or time interval at which oil should be changed, it is possible to classify passenger-car driving conditions in three basic types, and to consider oil-change intervals that will constitute a safe and sound practice with a minimum of expenditure.

Favorable driving conditions:

- Country driving at high temperatures.
- Newer cars in warm-weather use.
- Oil drains at intervals up to 2000 miles.

Unfavorable driving conditions:

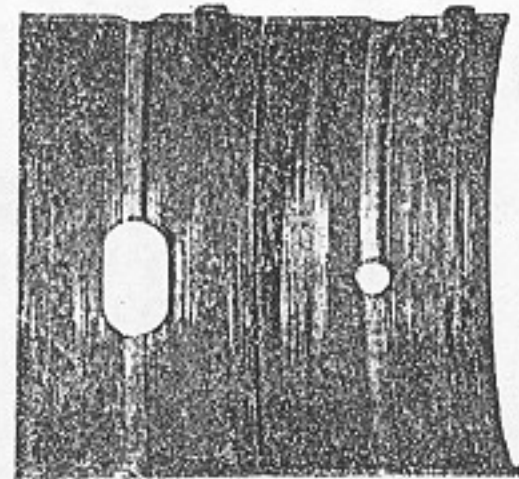
- Operation involving an excessive amount of engine idling, stopping and starting and no long runs.
- Operation in severe winter months.
- Oil drains as frequent as every 500 miles may be necessary.

Average driving conditions:

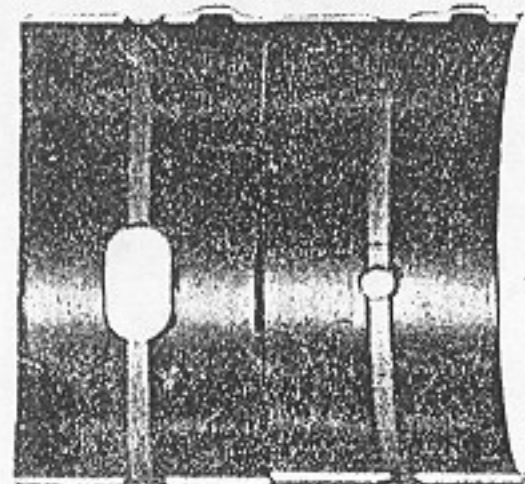
- Oil drains at 1000-mile intervals.

Although motor oil may be used longer than the above mileages, possibly with no ill effect, very little monetary saving is gained in relation to the risk which may be involved. Motor oil is a comparatively inexpensive commodity considering the highly important job it has to do, and one engine-repair job can readily cost considerably more than all of the oil required for a year's safe lubrication.

Information furnished by the Technical Advisory Committee, Pennsylvania Grade Crude Oil Assn.

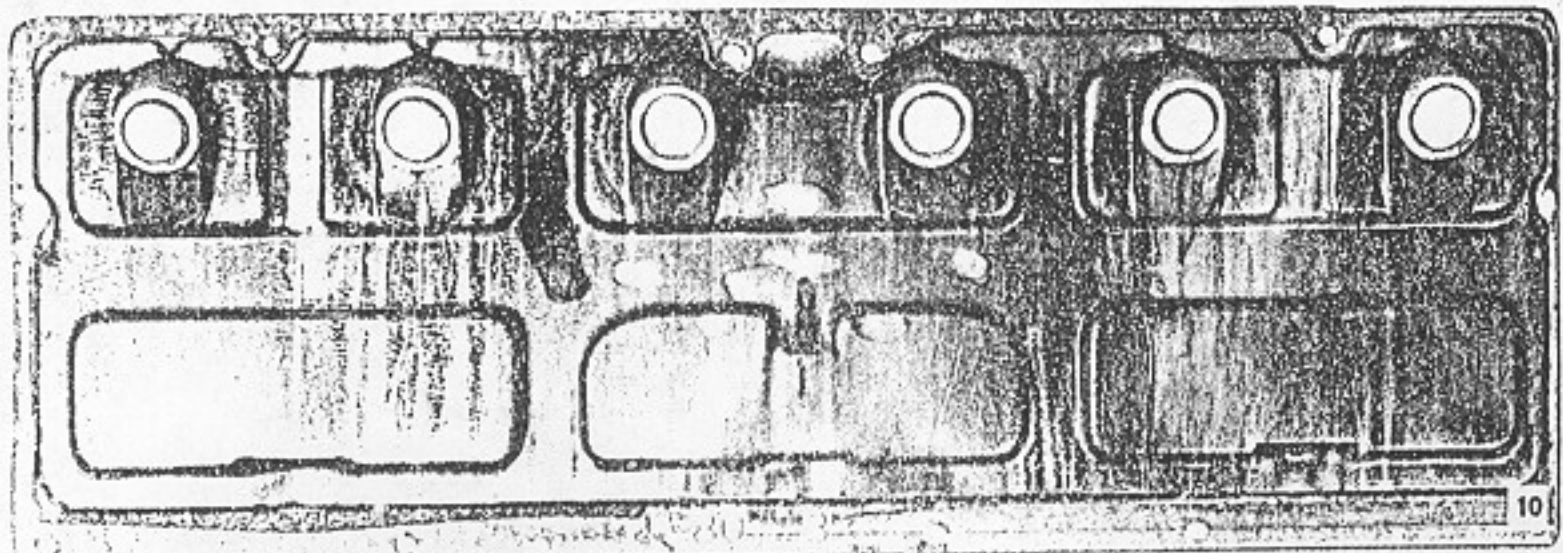


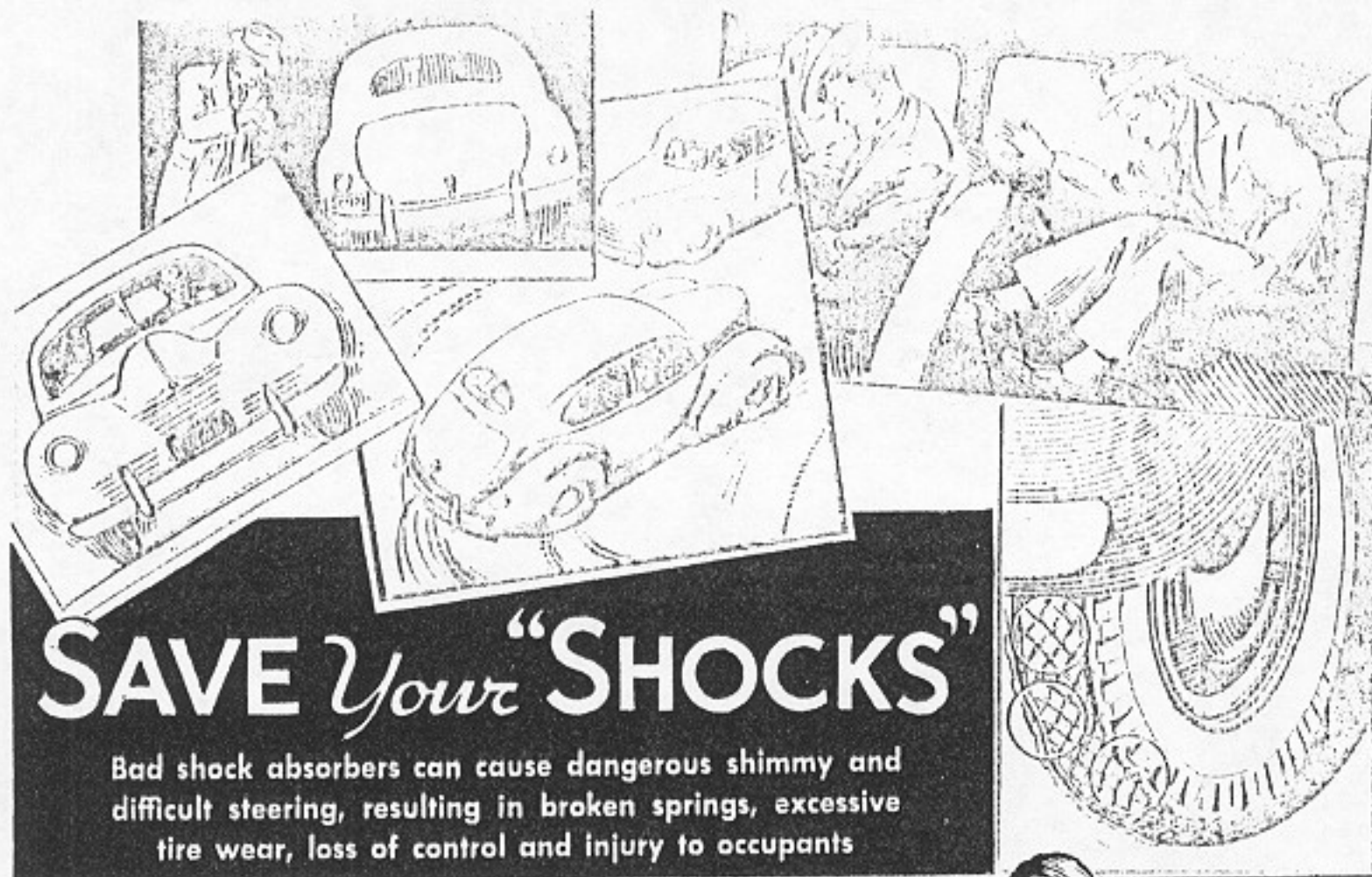
Actual road-test examples showing contrast between good and bad connecting-rod bearings



9

This clean side cover plate indicates that oil was changed and filters cleaned regularly at recommended intervals





SAVE Your "SHOCKS"

Bad shock absorbers can cause dangerous shimmy and difficult steering, resulting in broken springs, excessive tire wear, loss of control and injury to occupants

By C. E. Packer

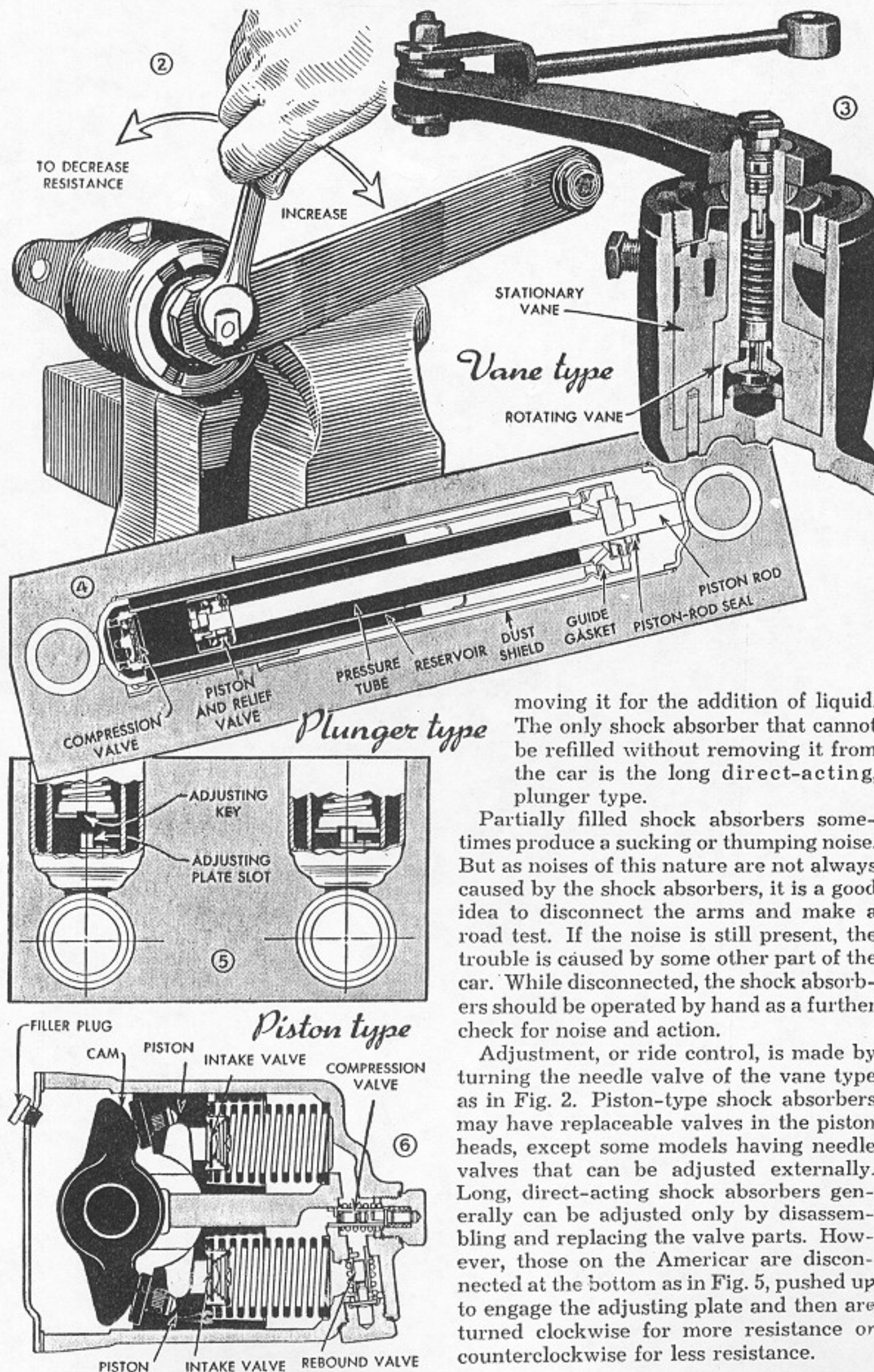
IT'S JUST as important to keep your shock absorbers correctly adjusted and properly filled with liquid as it is to keep oil in the motor crankcase. Shock absorbers that are not in good condition cause rough riding and may be the cause of an accident. When they permit a car to "bounce along," it is difficult for the driver to control the car, and at night the bobbing headlights may blind an oncoming motorist. Therefore, it is necessary that they be inspected at least every 5,000 miles to see if they are full of liquid, which also acts as a lubricant for the closely fitted parts that will wear rapidly beyond repair if the liquid gets too low. An easy occasional check is to stand on a bumper and bounce the car as in Fig. 1. If it rebounds two or three times after you jump off, the shock absorbers need attention. Such a check should be made at both ends of the car.

Most shock absorbers are similar in basic design and are of the vane type, Fig. 3, the plunger type, Figs. 4 and 5, or the piston type, Fig. 6. All depend on the resistance of a liquid being forced through orifices or valves, from one chamber to another, to control their action. The variation between shock absorbers is in the kind of liquid used, the type of valve or orifice, and the shape of the chambers. There are



two kinds of liquids: One is an oil and the other is a liquid containing glycerin and alcohol. In all kinds, it is very important to use only a prepared liquid made especially for your particular shock absorbers. Any substitute is likely to cause serious damage, as the liquids, besides lubricating the parts, must maintain a nearly uniform viscosity over a wide range of temperature and must not foam or gum.

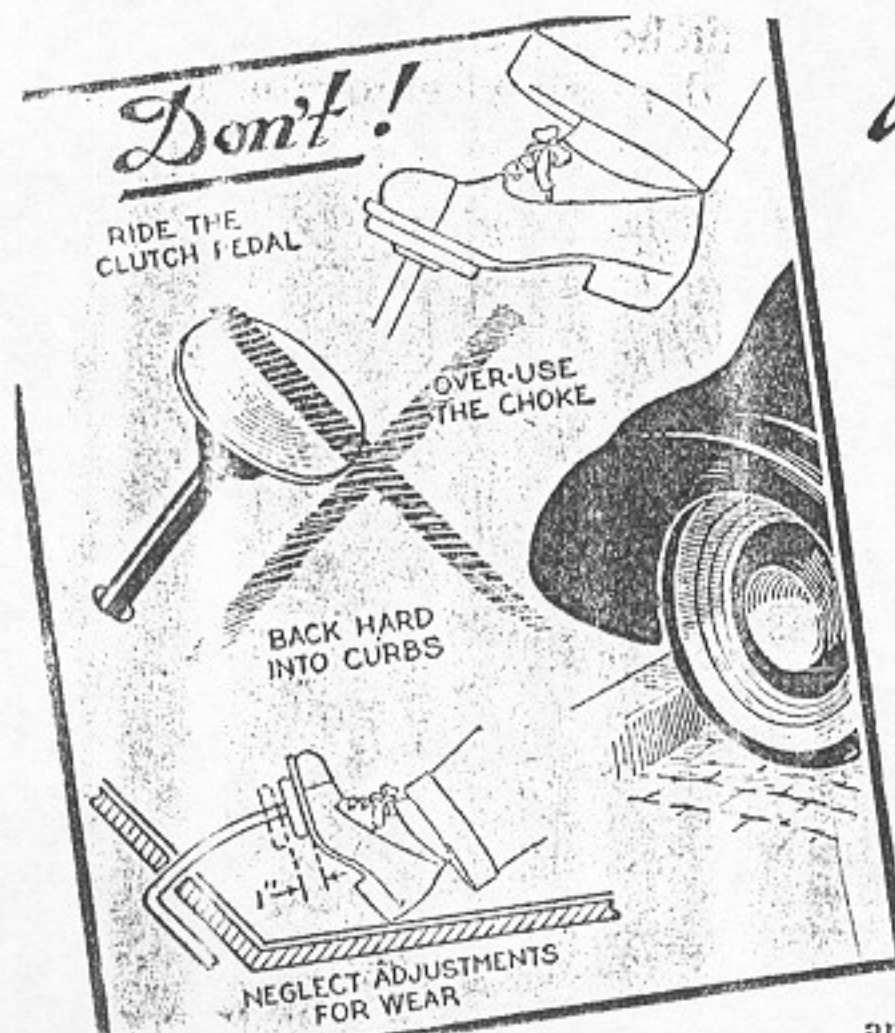
As any dirt that might enter the filler hole may clog a valve or orifice, or cause an abrasive action against the moving parts, it is important to remove all dirt and rust particles around a filler plug before re-



moving it for the addition of liquid. The only shock absorber that cannot be refilled without removing it from the car is the long direct-acting, plunger type.

Partially filled shock absorbers sometimes produce a sucking or thumping noise. But as noises of this nature are not always caused by the shock absorbers, it is a good idea to disconnect the arms and make a road test. If the noise is still present, the trouble is caused by some other part of the car. While disconnected, the shock absorbers should be operated by hand as a further check for noise and action.

Adjustment, or ride control, is made by turning the needle valve of the vane type as in Fig. 2. Piston-type shock absorbers may have replaceable valves in the piston heads, except some models having needle valves that can be adjusted externally. Long, direct-acting shock absorbers generally can be adjusted only by disassembling and replacing the valve parts. However, those on the Americar are disconnected at the bottom as in Fig. 5, pushed up to engage the adjusting plate and then are turned clockwise for more resistance or counterclockwise for less resistance.



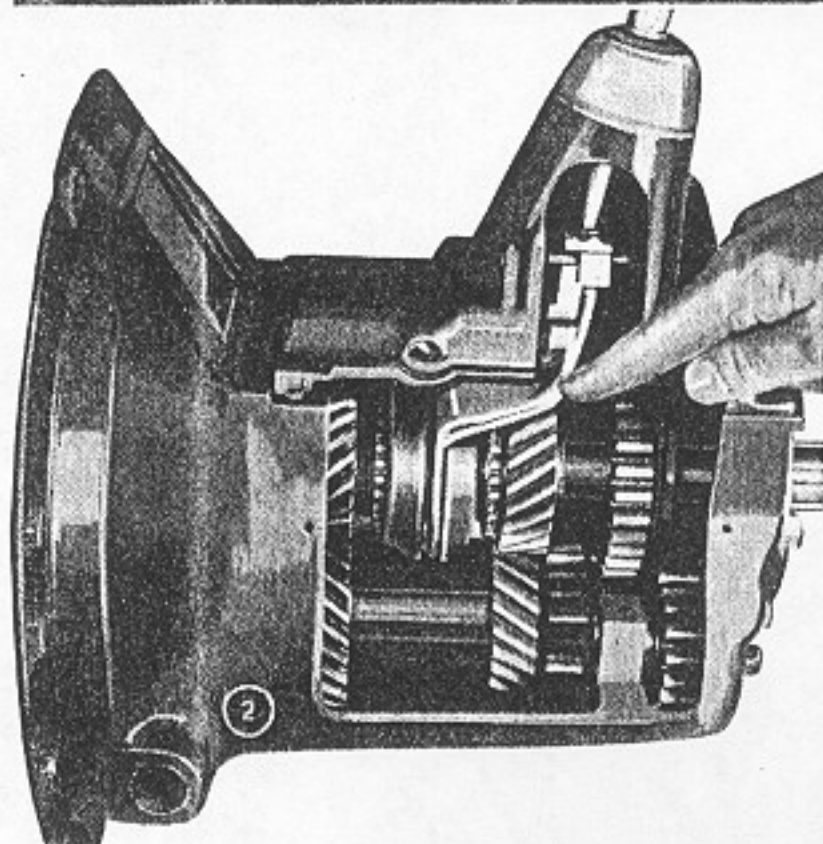
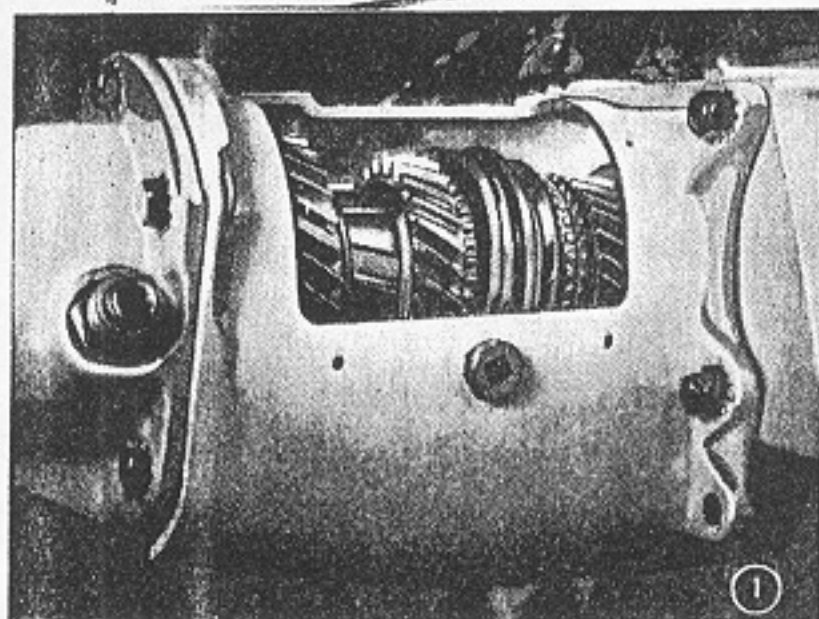
Pointers on

By C. E. Packer

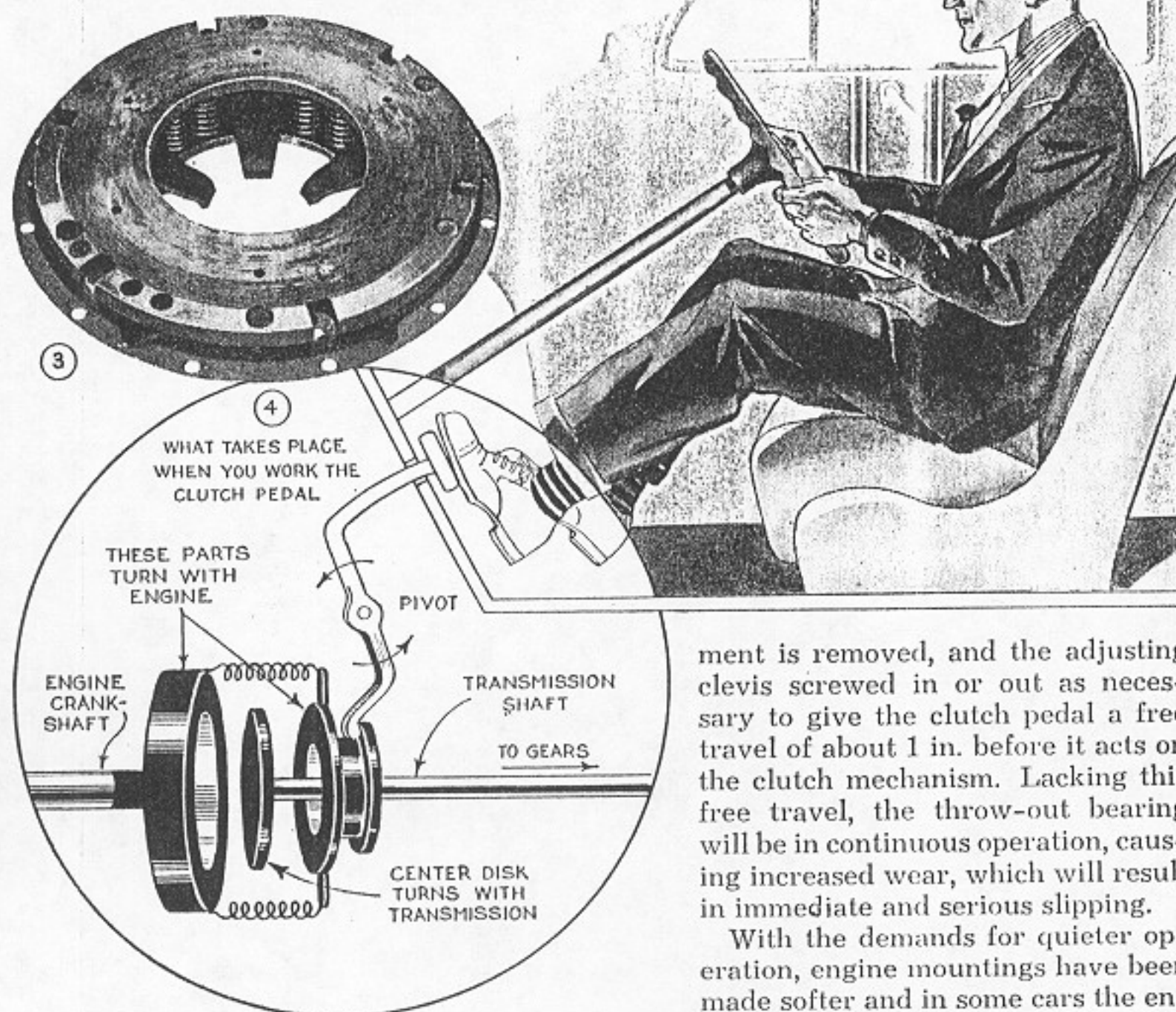
CLUTCH trouble does not always mean that the clutch itself is defective, but that its operation is unsatisfactory, which may be caused by almost any part of the drive mechanism, especially the transmission. Anything that causes the transmission gears to clash when shifting them or causes the clutch to grab, throws undue strain on the gears, shafts and bearings throughout the drive system. This causes excessive wear and even breakage of the parts.

Protection of the transmission with a high-quality lubricant is vital in two ways: It reduces wear and prevents excessive clutch spin. Also, "riding" the clutch—keeping your foot on the pedal while driving—causes unnecessary wear. Light contact of the foot brings the throw-out bearing into play and exerts end thrust on the crankshaft, creating end play prematurely while slightly increased pressure on the pedal contributes to slipping, which wears out the clutch-plate lining and may damage the pressure plate as in Fig. 3. There is no wear of any kind on the clutch when no pressure is applied on the pedal.

In order to shift gears noiselessly, the engaging gears should be running at approximately the same speed. Even when shifting "syncromesh" transmissions, having the parts to be united operating at similar speed is desirable. Therefore, the center disk that turns with the transmission is made as light as possible. This, in conjunction with the predetermined drag of the lubricant, brings the clutch to rest quickly when the foot pedal is depressed. Insufficient lubricant or lubricant with too light a body allows free spinning of the clutch, which contributes to wear in several parts and to difficulty in shifting. If lubricant of the proper kind as recommended by the manufacturer, is kept up to the bottom of the inspection-hole plug shown directly below the transmis-



CLUTCH CARE



sion opening in Fig. 1, little trouble will be experienced. When gears have a tendency to slip out of mesh, the cause may be wear or a sprung shifter fork, as indicated in Fig. 2. When the fork is sprung, the gears of the old-type transmission or the synchronizing unit of the modern transmission are not moved far enough to mesh correctly.

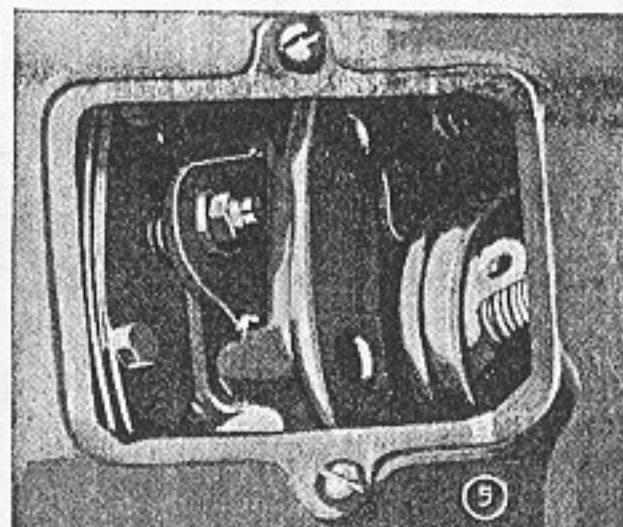
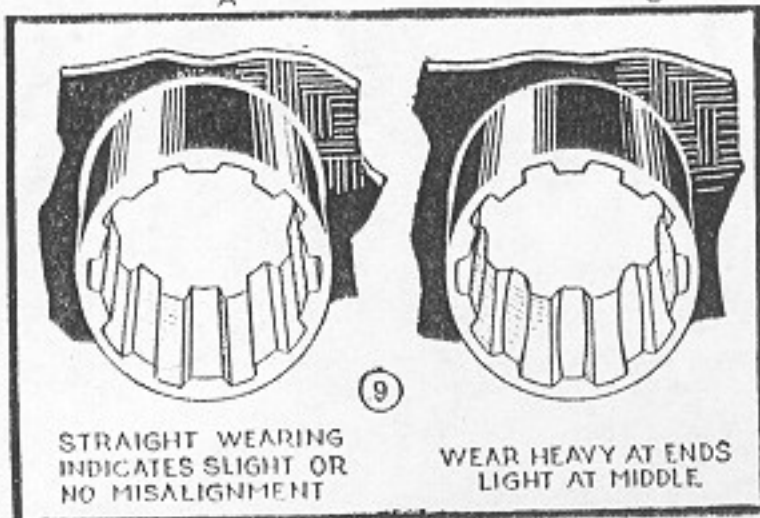
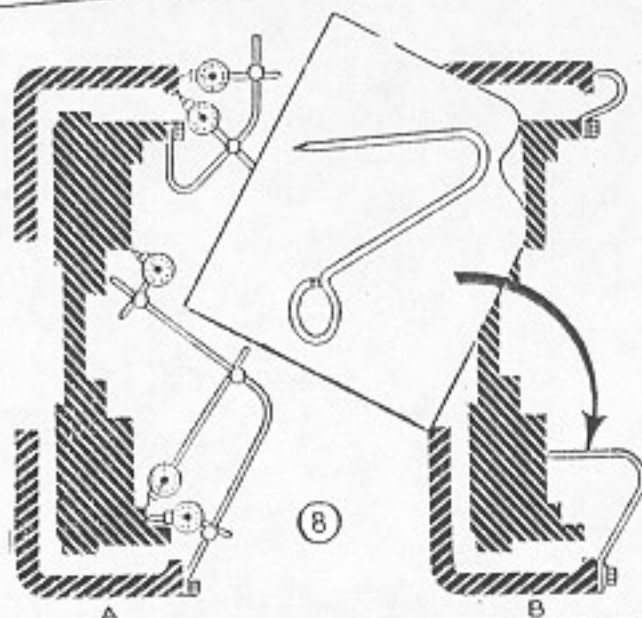
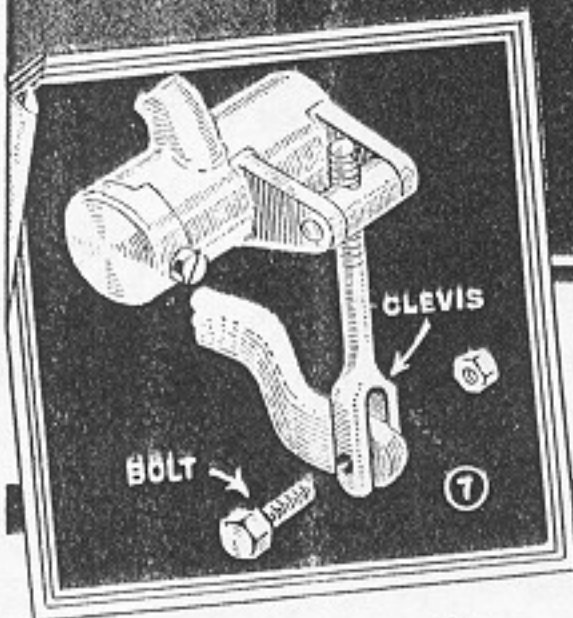
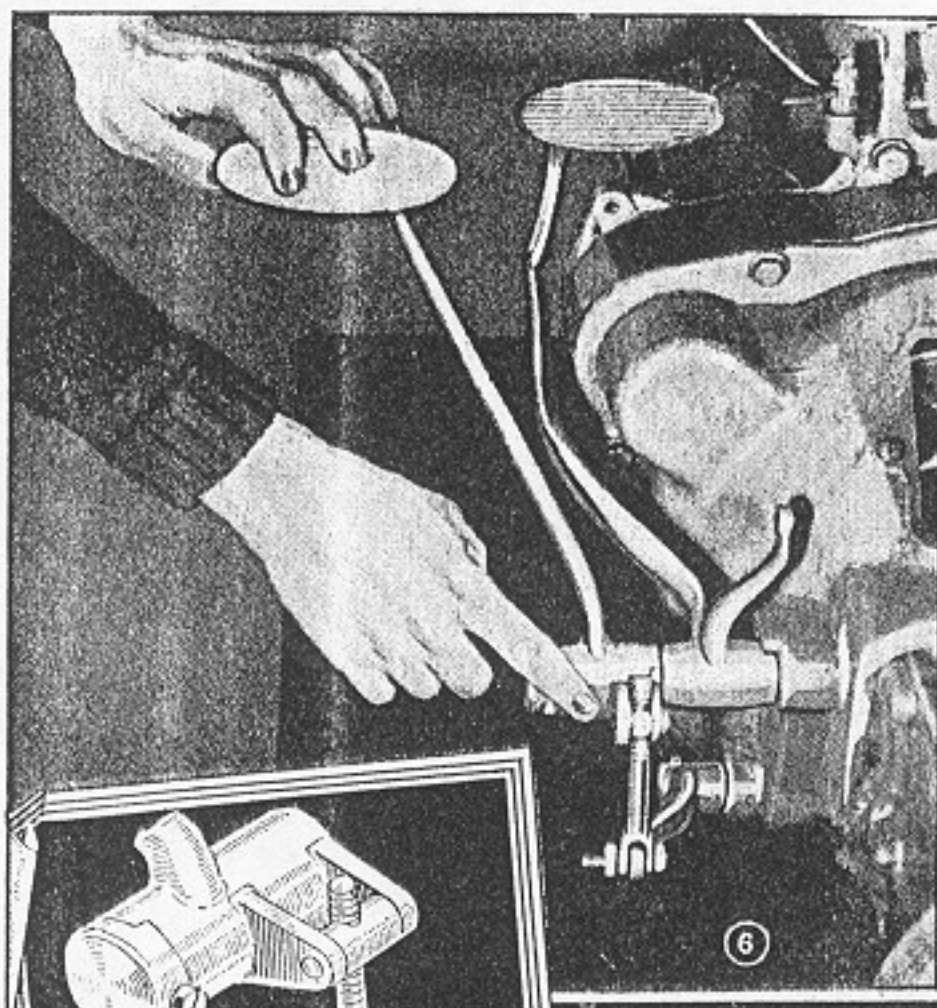
Wear in the throw-out mechanism of a clutch should be adjusted promptly. If it is not done, the clutch may drag or slip, with the result that gears or synchronizing parts cannot come to rest or will not function properly. Few clutches have any adjustment within the clutch housing. Most adjustments are made by some combination of screw-and-bolt linkage between the pedal and the clutch shaft. A typical example is seen in Figs. 6 and 7. Here the pin at the lower end of the screw adjust-

ment is removed, and the adjusting clevis screwed in or out as necessary to give the clutch pedal a free travel of about 1 in. before it acts on the clutch mechanism. Lacking this free travel, the throw-out bearing will be in continuous operation, causing increased wear, which will result in immediate and serious slipping.

With the demands for quieter operation, engine mountings have been made softer and in some cars the engines are free to move considerably.

Therefore, the power pulsations from the engine are transmitted through the clutch. Consequently, when engine movement becomes excessive due to matting down or weakening of its supports, strains on the clutch become greater and trouble results. Sometimes clutch trouble has been stopped by replacing or tightening the engine mountings. In the case of chronic clutch chatter, a general tightening of the chassis often has proved effective. When we realize that the full power of the engine is transmitted through a clutch disk no larger than a dinner plate, it will be appreciated that any jerking resulting from looseness in the drive line can break momentarily the grip of the clutch, and cause a slight slip, which in itself is not serious but causes wear on the clutch facings over a period of time.

Looseness of rear-wheel hubs on axle



shafts, or even looseness of the wheels on hubs over a period of time may cause clutch trouble. Also, excessive play between the pinion and ring gear within the rear axle, or between the differential side gears and the axle shafts, may result in trouble often diagnosed as a faulty clutch. And, any looseness in the driveshaft either in its splines or

at the universal joint, may be the cause of mysterious clutch difficulty.

The nuts on the clutch fingers seen through the clutch inspection opening in Fig. 5, should be adjusted only by manufacturers who have precision fixtures for the purpose. The fingers can be seen in more detail in Fig. 3, this clutch having six fingers, all of which must be at exactly the same height. When the complete clutch pressure plate is assembled at the factory, all of the ten or more springs, and six or more fingers are checked accurately. In time, the springs may become weakened and cause trouble, but if any attempt is made by an inexperienced person to compensate for this condition by adjusting the clutch finger nuts, slipping or grabbing is almost certain, with the result that further damage will be done.

In cars that have a torque-tube drive (tubular housing covering the torque tube between the transmission and rear axle), careless handling of the car may cause clutch trouble. For example, should an owner of such a car back up against a solid object, the impact would be transferred directly to the rear end of the motor, which is the clutch housing. This could cause misalignment between the clutch housing and the flywheel. Detail A of Fig. 8 shows the manner in which experienced mechanics check the alignment between the fly-

wheel and the clutch housing with the use of precision gauges. Detail B shows a similar check that any car owner can make when servicing his own clutch. By taking a length of stiff wire bent to the shape shown, it will be possible to check "run out" of the flywheel. If the "run out" exceeds .005 in., the resulting misalignment between the clutch housing and the transmission will cause excessive wear of the spline in the hub of the clutch plate, Fig. 9. Often, by tightening one flywheel bolt slightly more than another, this condition can be corrected within reasonable limits. A squealing noise within the clutch may indicate that the bearing supporting the front end of the clutch shaft is in bad condition, or that the throw-out bearing is running dry. While some throw-out bearings have provision for lubrication, many of them are lubricated for life.

One of the most disturbing clutch actions results from lack of lubrication of the pedal shaft or some related part. Under such conditions, the clutch may stick temporarily, then take hold suddenly. Naturally this throws tremendous strains on all parts of the car. This condition is particularly likely to develop in cars that are operated

where salt is distributed on pavements to thaw the ice. The judicious use of penetrating oil on all moving parts that enter the clutch housing, which is done while moving the clutch pedal in and out, will clear up this trouble. Any tendency of the pedal to rub on the side of the opening where it passes through the floor of the car may cause trouble.

Speaking of jerking operation, it may seem far-fetched to point out that faulty use of the choke can injure the clutch, but such is the case. The jerking action of an engine that is operating on too rich a mixture (or missing for any other reason) causes strain on the clutch. Another thing that is responsible for clutch difficulty is the use of too light a lubricant in the transmission, or too much of it, with the result that some may work forward onto the clutch and cause slipping or grabbing. A loose rear main bearing in the engine may also cause this trouble by allowing oil to pass from the engine into the clutch. A clogged breather on the engine may have the same effect, in which case the pressure built up in the crankcase by blow-by around the pistons will force oil out of the main bearings.



The next time you make a Jack-o'-lantern or use fresh pumpkin in a recipe, save the seeds to roast. It's such a simple process that even small children can do it. Some people eat the entire seed; others discard the outer shell and eat only the center portion.

GOOD IDEA

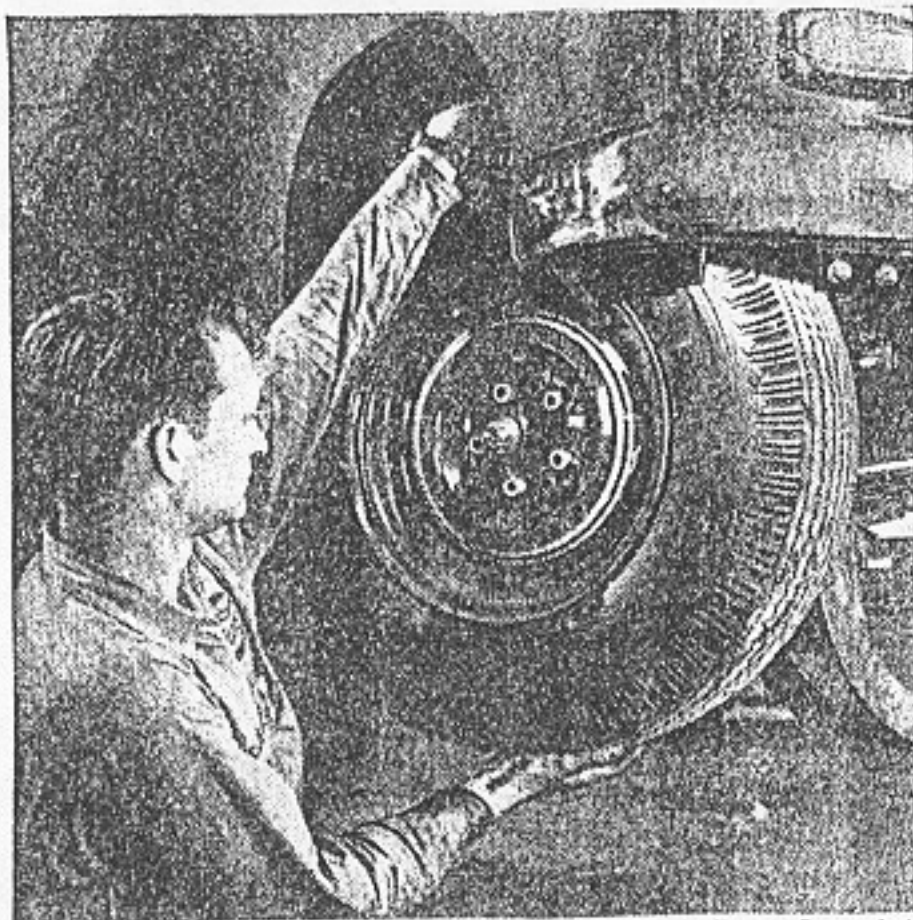
Toasted pumpkin seeds

Sunset - October 1963

Toasted Pumpkin Seeds. Wash fibers from pumpkin seeds; drain off excess water. Sprinkle a solid layer of salt in the bottom of a cookie pan or other shallow baking pan. Arrange seeds in a single layer on the salt. Place in a moderately slow oven (300°) for 45 to 50 minutes, or until seeds are lightly browned. Cool in the pan. One medium-sized pumpkin yields about 1 pint seeds.

CAR WHEELS

Like any fine mechanism, wheel bearings need attention to withstand constant use. Proper adjustment, cleaning and lubrication keep them in top condition



Kaiser-Frazer Corp. photo

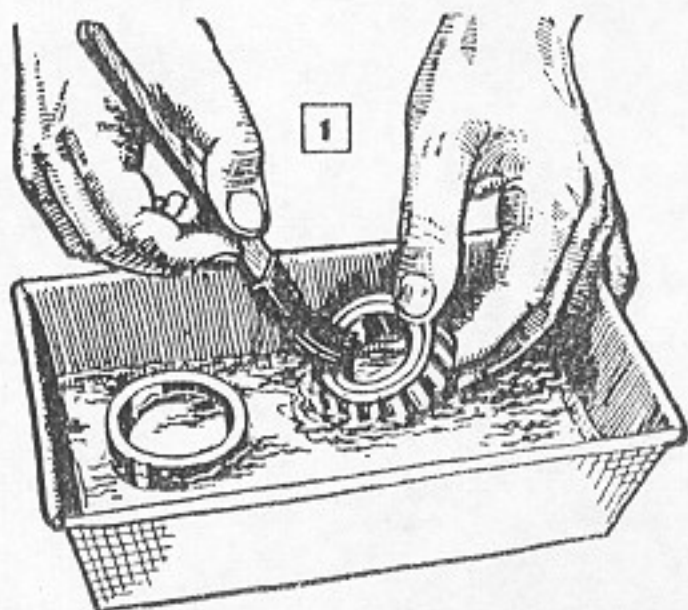
Testing front-wheel bearings for looseness by rocking wheel. Do not mistake kingpin movement for wheel-bearing looseness

ROLLING contact bearings on each of the four wheels support the entire weight of a car. These bearings are expertly designed and engineered for extremely long service, and with only occasional attention they usually last for the life of the car. Under ordinary conditions, it is advisable to remove the wheels and inspect and clean the bearings at least once a year—oftener under extreme conditions.

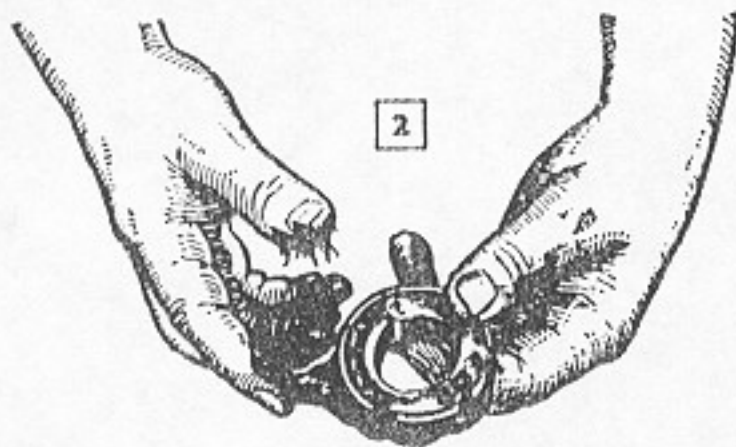
The most common causes of bearing malfunction are: (1) rust due to worn or defective seals or condensation inside the housing; (2) worn, galled or abraded surfaces resulting from too loose a fit or dirt lock; (3) broken or bent inner ring, shields,

seals or separators caused by improper or careless installation, and (4) damaged raceways, balls or rollers due to dirt or pitting by corrosion. Badly discolored balls and races indicate inadequate lubrication. Dirt or pitting by corrosion is indicated by a general roughness, and excessive looseness or end play is evidence of lapping by dirt or abrasive. Parts are a dull-gray color when lapped or abraded by dirt.

The principal parts of a ball bearing are shown in Fig. 4. Variations of this bearing will be found in the different makes of cars, but basically they are the same. Wear is virtually absent unless foreign matter finds its way into the bearing. However, any



Soft brush assists cleaning of bearings in gasoline. After washing, handle parts only when necessary



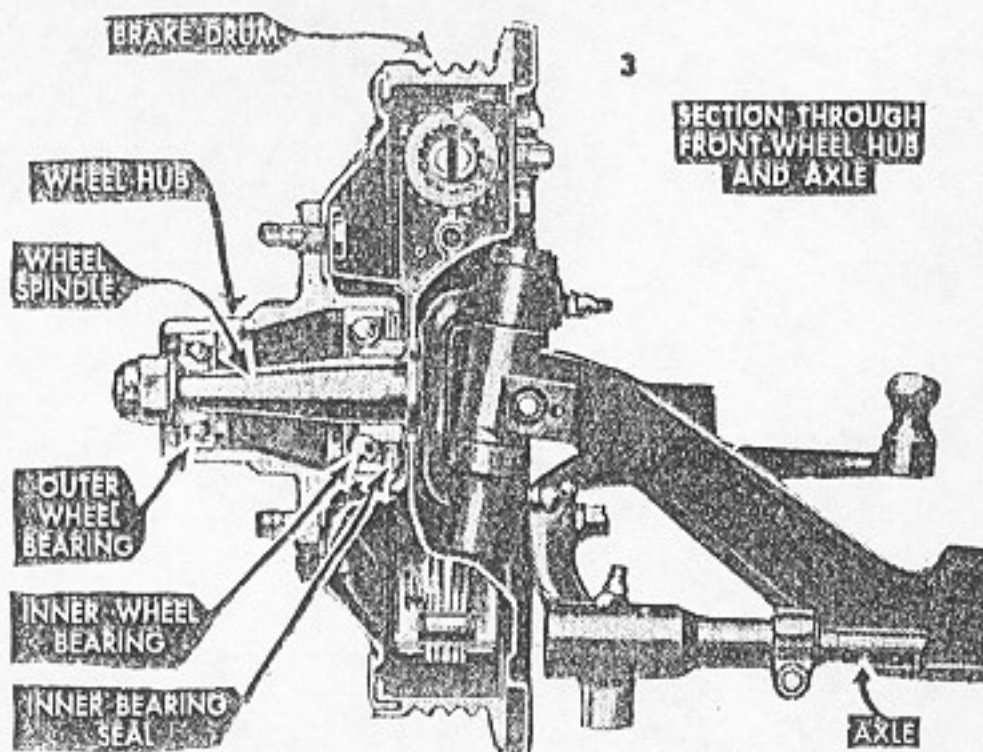
Bearing is packed with wheel-bearing grease made especially for purpose. Substitutes should not be used

abrasion or injury to the surfaces may lead to bearing failure, and hitting or dropping a bearing is likely to damage it beyond repair. Also, incorrect kind or amount of lubricant may cause heating or corrosion.

Fig. 3 shows a typical bearing arrangement for the front wheels. To service these bearings, jack up the wheel and remove the ornamental cover and hub cap, if any. Next, remove the cotter pin from the spindle nut and unscrew the nut. Pull the wheel off slightly to loosen the outer bearing and then push the wheel back in place. Carefully remove the outer bearing and place it on a clean piece of paper. The wheel can then be completely removed from the axle. Now, slip the inner bearing and grease retainer from the hub and place them on the paper also. After this, all parts, including the wheel hub and axle spindle should be thoroughly washed in white gasoline and allowed to dry, Fig. 1. Do not handle the bearings more than necessary after cleaning, as perspiration tends to corrode them. Inspect the grease retainer and brake assembly for grease leakage. As this retainer keeps the lubricant within the bearing area and away from the brakes, it should seal tightly. Inspect the bearings for wear and damaged balls or rollers and check for play between the balls and races. However, do not spin the bearing before it has been lubricated. Coat the bearings and the axle spindle with wheel-bearing grease, Fig. 2, but do not use ordinary chassis lubricant or other substitutes. If new bearings are necessary, be sure to get duplicates of the ones being discarded.

To reassemble the parts, first press the inner bearing and grease retainer into the hub. Mount the wheel on the spindle, being careful not to damage the grease retainer, and insert the outer wheel bearing, applying the spacer washer and castle nut. Rotate the wheel slowly, tighten the nut until the wheel just binds and then back off the nut slightly to insert the cotter pin. Check for bearing looseness by rocking the wheel, but first block the kingpin or have someone watch it, so that kingpin movement is not confused with bearing looseness. With the bearing properly adjusted there will be a slight drag when the wheel is turned slowly by hand. When the adjustment is right, secure the cotter pin.

The rear-wheel bearings, Fig. 5, do not require attention as frequently as those on the front wheels. The parts of the rear-wheel assembly are cleaned and the bearing checked in much the same way as those of the front wheel. However, a wheel puller will be necessary to remove the wheel. Probably a puller will also be needed for the bearing. If the bearing is lubricated by high-pressure grease fittings, be careful not to apply too much grease.



General Motors Corp. photo

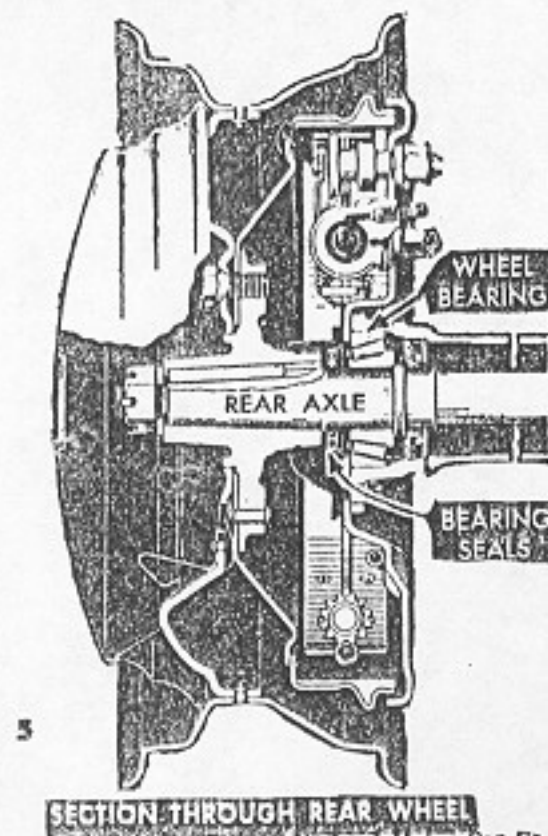
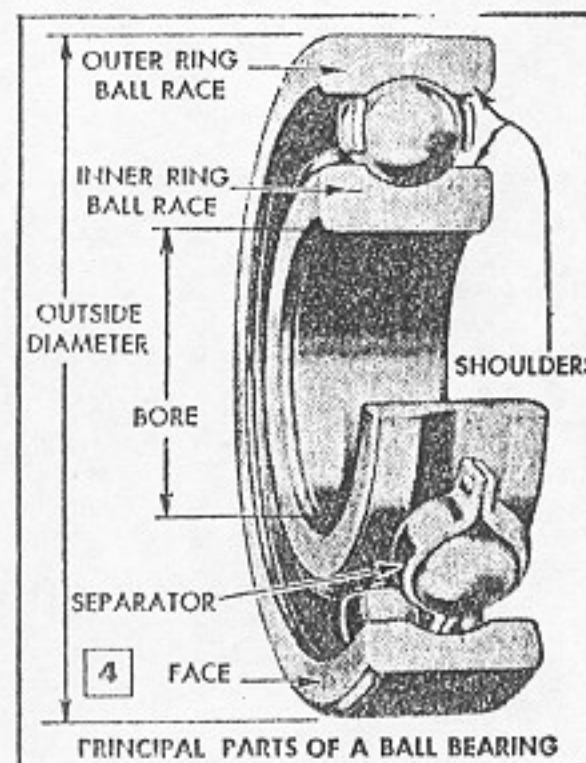
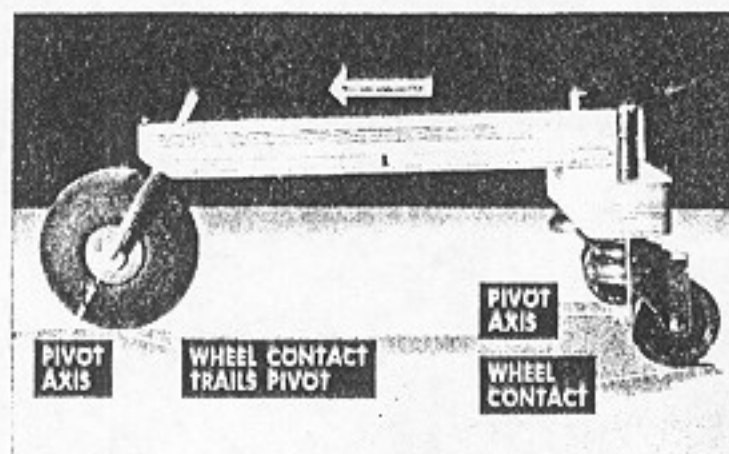


Diagram courtesy Packard Motor Car Co.

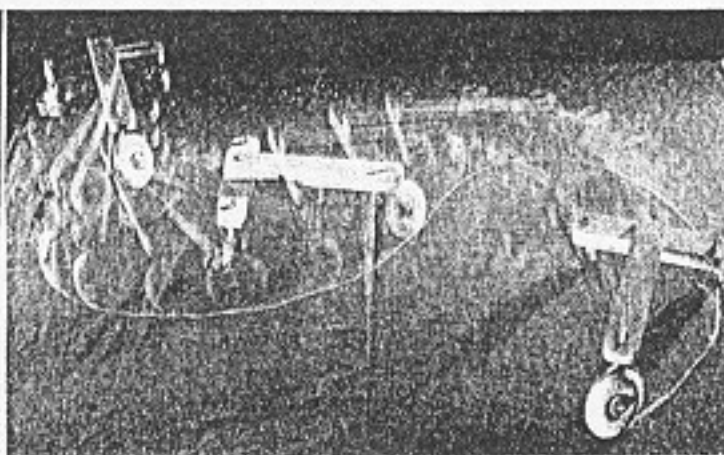
Models Show Why Car Wheels Need Alignment

By Harry Walton

Terms like caster, camber, kingpin inclination, toe-in and toe-out are confusing until you know the reasons for these simple engineering tricks. Lots of mechanics don't.

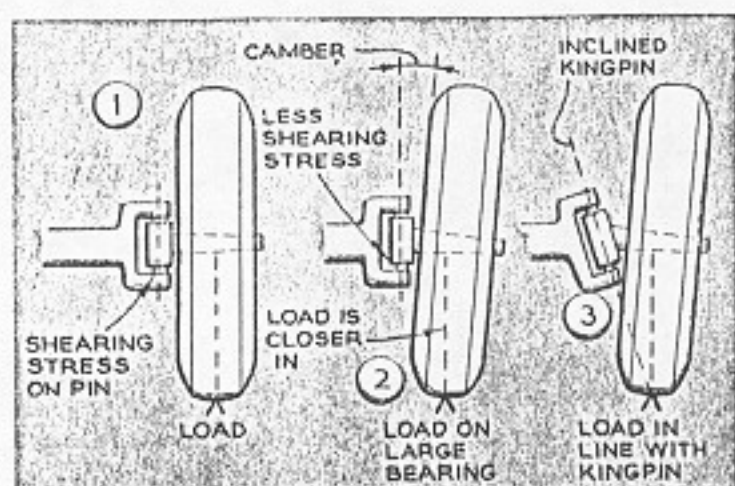


Caster. Ever try to push a piece of furniture with a reversed caster? It wobbles because the point of wheel contact is ahead of the pivot axis. But if the point of contact trails behind the pivot axis, direction is easily controlled. Front auto wheels are given caster for the same reason. In the model at left, above, the single wheel on the inclined pivot axis (kingpin) shows the method



used. While it looks like a reversed version of the casters at the rear, the two are actually alike because, here again, the point of wheel contact is behind the pivot axis.

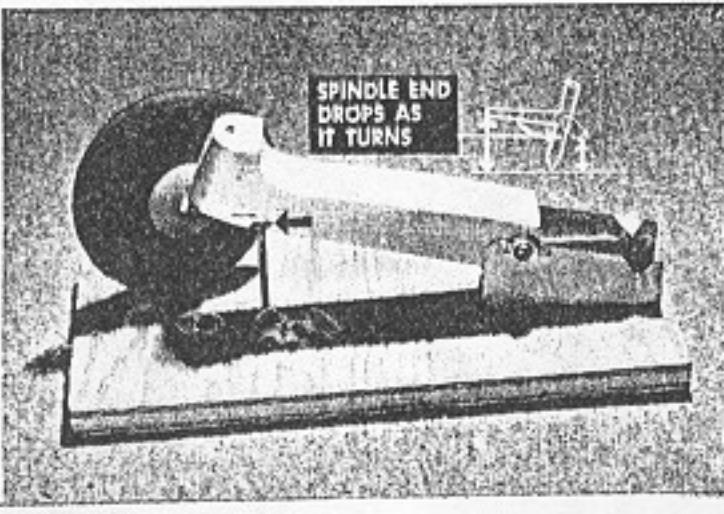
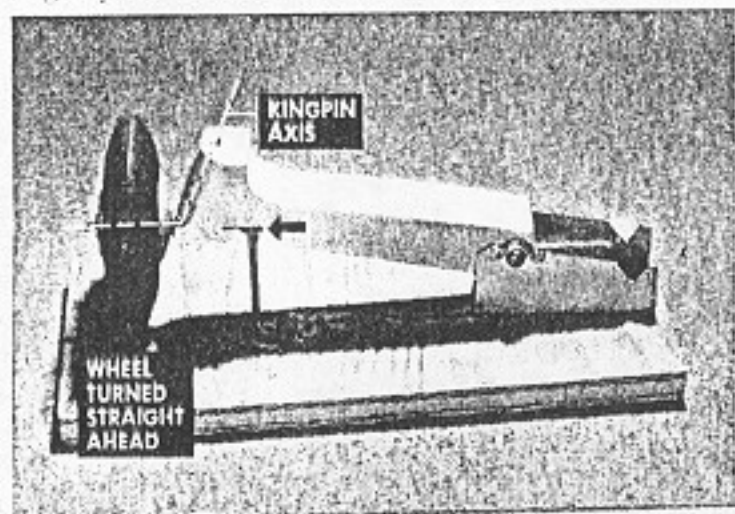
The multiple-exposure photograph at right, above, shows that both types of castered wheel will swing in whatever direction the model is being pushed.

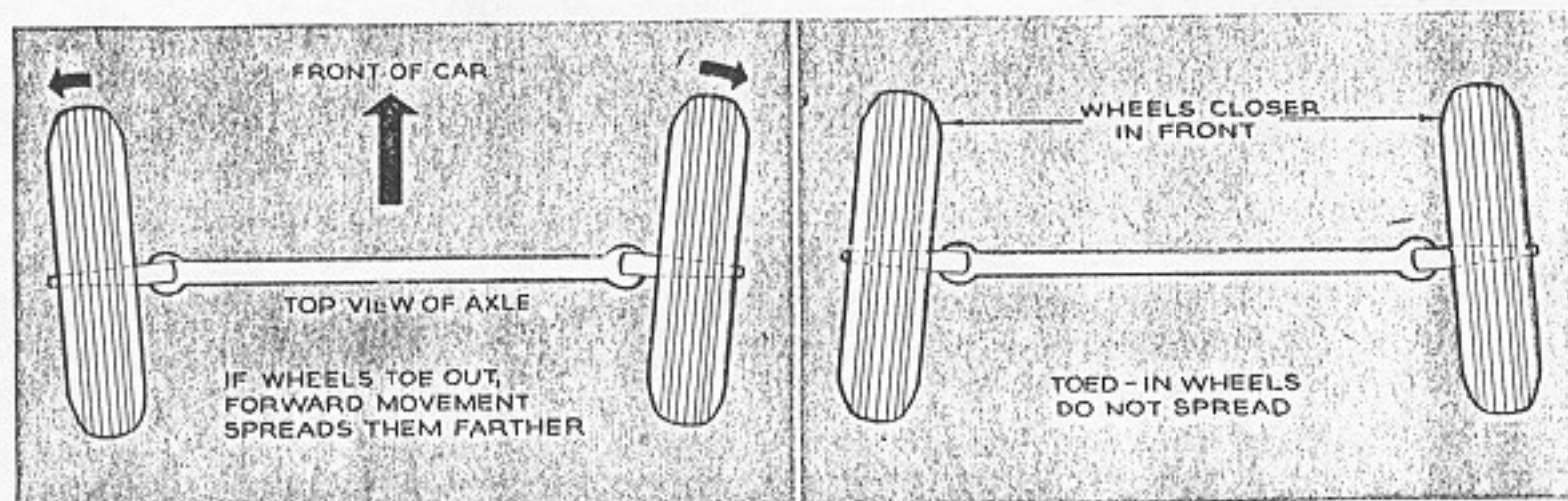


Camber. View of a much simplified wheel, spindle and axle at left shows that the load represented by the weight of the car comes between the wheel bearings (1). This looks reasonable until you consider that this off-center thrust is constantly trying to bend up the spindle and shear the kingpin. By tilting the spindle downward slightly, the wheel leans out at the top (that's camber) and you bring the load line closer to the main bearing, giving it less leverage to shear the kingpin (2). Front-wheel brakes required longer spindles, aggravating the problem. It was met by inclining the kingpin also, so its axis meets the load line (3).

Kingpin inclination not only brings load of car in line with the kingpin axis, but also adds steering stability, making the car tend to keep a straight course and even come back to it after a turn. The mockup below shows why. With wheel straight ahead, spindle is parallel to ground (or slightly downward because of camber angle). As

steering turns the spindle body, end of spindle tends to swing down farther. Since it can't push the wheel into the ground, it raises the car. Pencil mark (arrow) shows how the axle rises as the wheel is turned from straight-ahead position. The weight of the car seeks to turn wheel back straight.

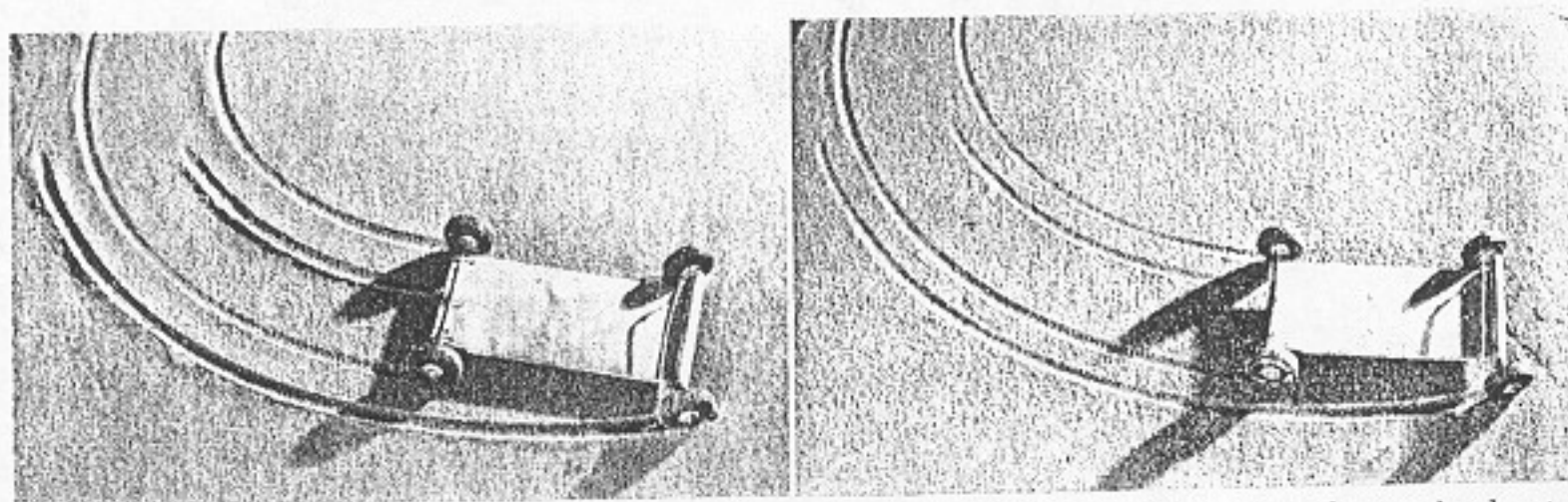
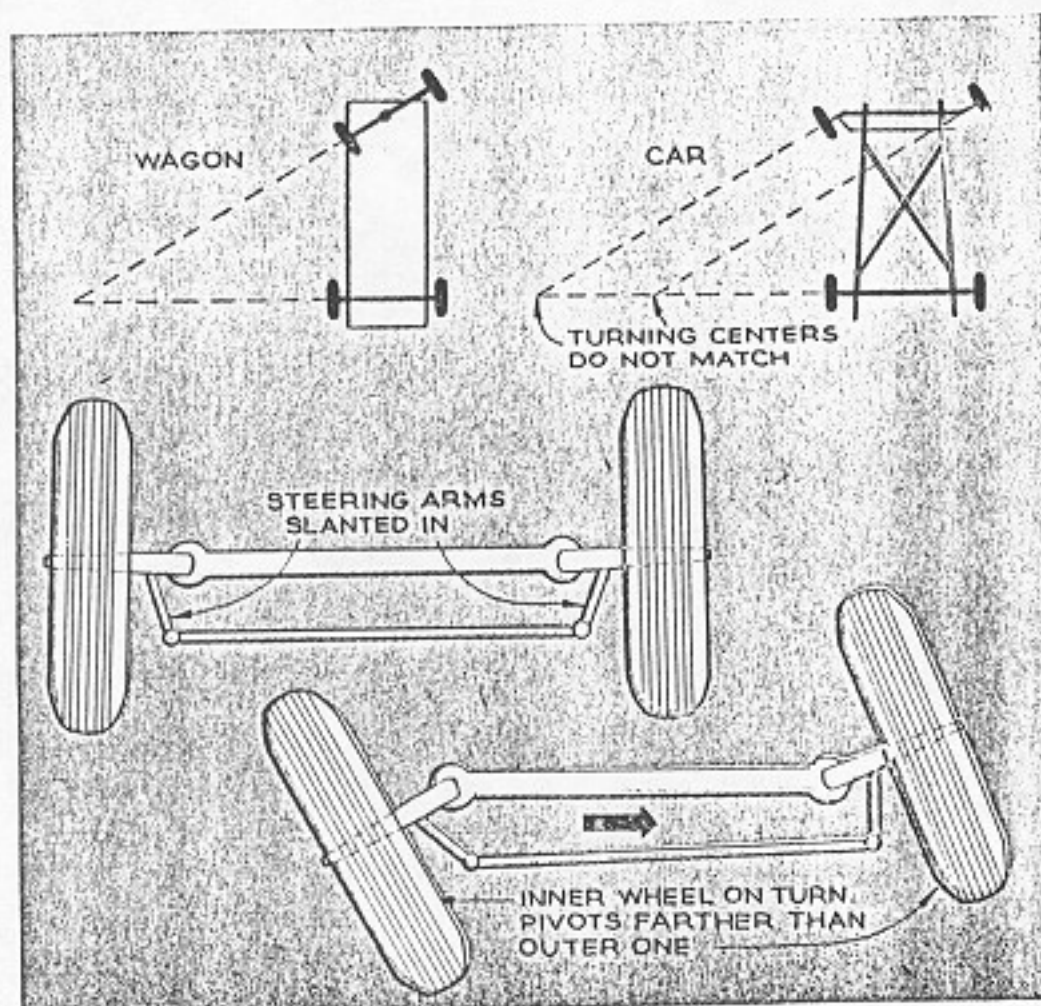




Toe-in. If front wheels swung on their kingpins without a tie rod between them, you can easily imagine how they would both fold back when the axle was pushed forward. Even with the tie rod, tendency would remain, increased by brak-

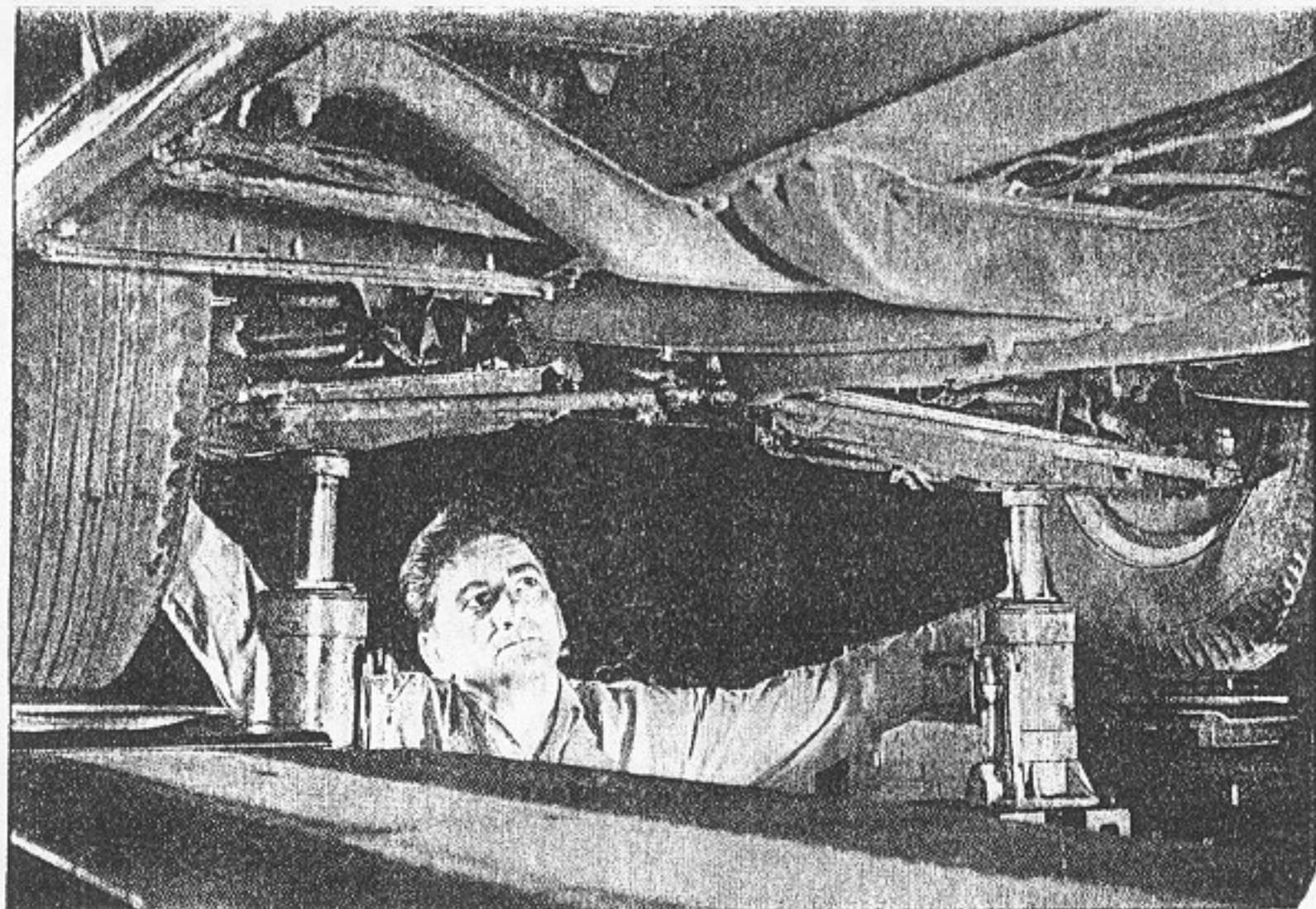
ing action that would wear tires and transmit every road shock directly to the tie rod. Toeing in the wheels slightly while they are pointing straight ahead counteracts their natural tendency to spread apart.

Toe-out. In buggy days, the pivoted front axle and the fixed rear one swung around a common turning point. But when front wheels were independently pivoted on a rigid axle, swinging both equally gave them a different turning radius, only one of which could be the same as that of the rear wheels. The inside front wheel has to be turned farther than the outside one to have the same turning center. Faced with the problem of having toe-in with wheels straight and toe-out when in a turn, engineers solved it by slanting the steering arms. Move both equally, and the inner one swings farther from the straight-ahead position.



Why tires wear if front wheels don't turn on the same center is shown by sand tracks of a four-wheeled model (left). Rear wheels make sharp clear tracks. Front wheels (in this case with excessive toe-out) throw up a ridge of sand. Bat-

ting each other, they are being dragged sidewise in their own tracks. With proper toe-out, front wheels make tracks as sharp as rear ones (right), proving they are not being subjected to any sidewise thrust.



How an Expert Aligns an Auto's Front End

It takes delicate instruments and a lot of know-how to keep the wheels of modern high-speed cars rolling true and safe.

By Howard G. McEntee

WHEN old Dobbin was a colt, buggies and wagons rolled around corners with ease. But in this motorized age, you have to go to specialists like Arnold Nadworny to keep your car taking the turns properly.

Nadworny is a wheel-alignment specialist. Every working day he deals with the intricacies of caster, camber, toe-in and kingpin inclination—all part of that mathematical jungle, front-end geometry, that confuses so many apprentice mechanics.

Knowing how to make adjustments, Nadworny is convinced, is just the beginning of what a good front-end man should know. He should also know why. Nadworny has a success story to tell about that—his own.

Some years ago he was a traveling trouble shooter for a manufacturer of the type of equipment he now uses. Hit by a yen to

settle down, he looked around for a likely place to establish his own shop.

The community he picked already had several alignment shops, all reasonably successful. But Nadworny knew that they had a failing in common. They could do a front-end job, but the operators had never bothered to find out the reasons for what the books told them to do. Some even used their equipment incorrectly.

It Takes More Than Fancy Gauges

Nadworny's confidence that he could get a slice of the business by doing a better job has paid off. His shop is now a leader in the community.

One thing strikes you when you take a car to Nadworny's shop—the amount of work he does, the checks he makes, before taking even one reading from those fancy gauges you associate directly with front-end

alignment. But without this preliminary work, he explains, you never could know whether the readings you get are correct.

The first rule for aligning a front end is that the car must rest on a level surface. And the car won't rest level if tire pressure isn't equal all around.

So Nadworny, like all thorough front-end men, makes sure that incorrect tire pressure, spring sag, spring shackles, shock absorbers and bent or eccentric wheels are not causing the car to tip one way or the other. This check includes the whole car, not just the front end.

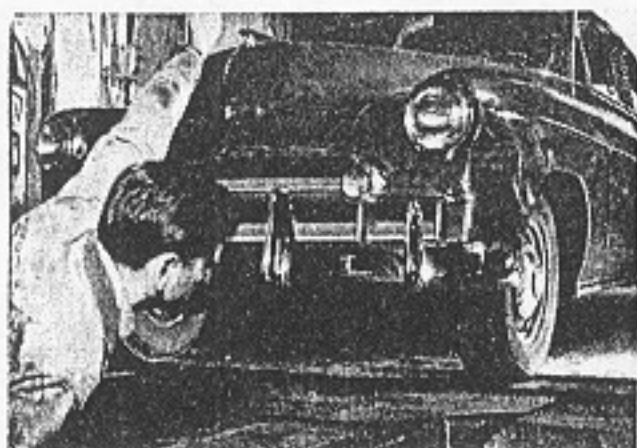
Each Maker Has Own Specifications

At the front end, checks and any necessary adjustments are made of the spindle bolts and bushings, the wheel bearings, tie-rod ends, the upper and lower support-arm pins and bushings, the lower control arms and bushings, steering arm, spindle, axle, torque and radius arms and wishbones.

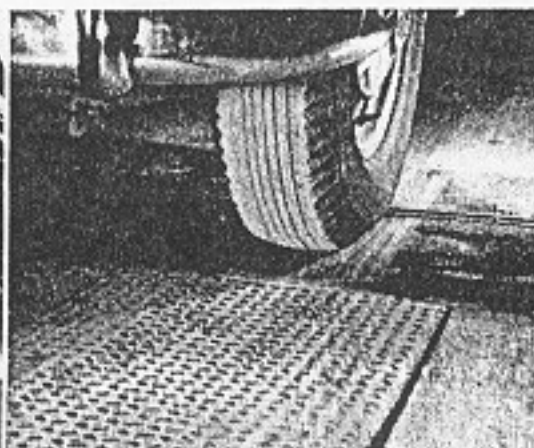
Then, finally, comes the alignment itself. Camber, caster, toe-in, kingpin inclination and toe-out on turns all are brought to specifications furnished by the car manufacturer. (To understand these confusing terms, see experiments that follow this article.)

Specifications vary considerably from car to car and year to year. Surprisingly enough, some manufacturers specify no camber and toe-in as the ideal. That has been the case with all Chrysler-made cars since around 1940, and the corporation has sought to impress on its mechanics that "front wheels straight ahead and straight up and down" is the goal to shoot at. Lately, Plymouth has also listed zero caster as the ideal specification.

In the old days, mechanics could do a pretty good job of hitting alignment angles by eye. But knee-action front ends brought complications. Today it takes specialists like Arnold Nadworny, using specialized equipment, to do the job right.



1 Beginning a job, Arnold Nadworny guides car up ramp of alignment tester. As front wheels begin to climb ramp they cross toothed bar, giving a toe-in reading on the dial at the left.



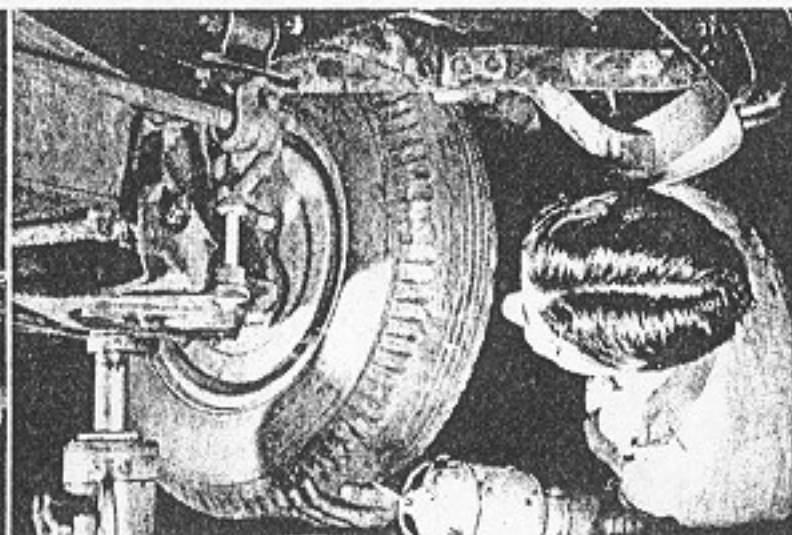
2 Toothed bar, free to move sideways, records how much tire is dragged sideways. Same toe-in measurement can be made on rack. Wear on inside treads here suggests alignment is needed.



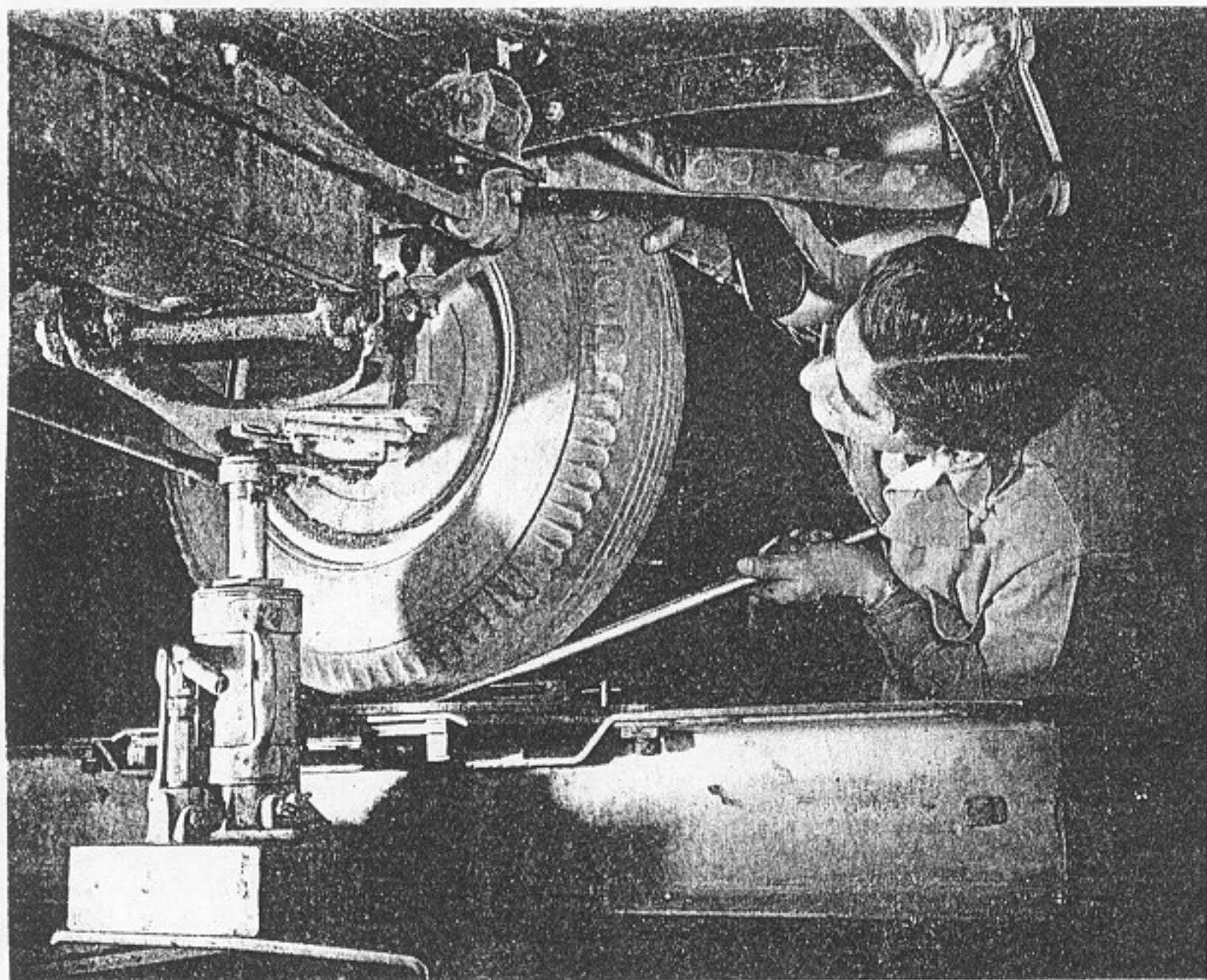
3 Too much toe-in was one trouble, so Nadworny corrects it first thing. Toe-in is adjusted by changing length of tie rod or rods. Screw arrangement here facilitates the job.



4 Before other alignment checks, Nadworny inspects wheel bearings, repacks them and removes looseness. Early in game, pressures also are brought to same reading in all tires.



5 Jacked-up wheels are shaken vigorously to see if there is play in kingpin bushings or knee-action parts. It is rarely worthwhile to attempt wheel alignment if such parts are worn.

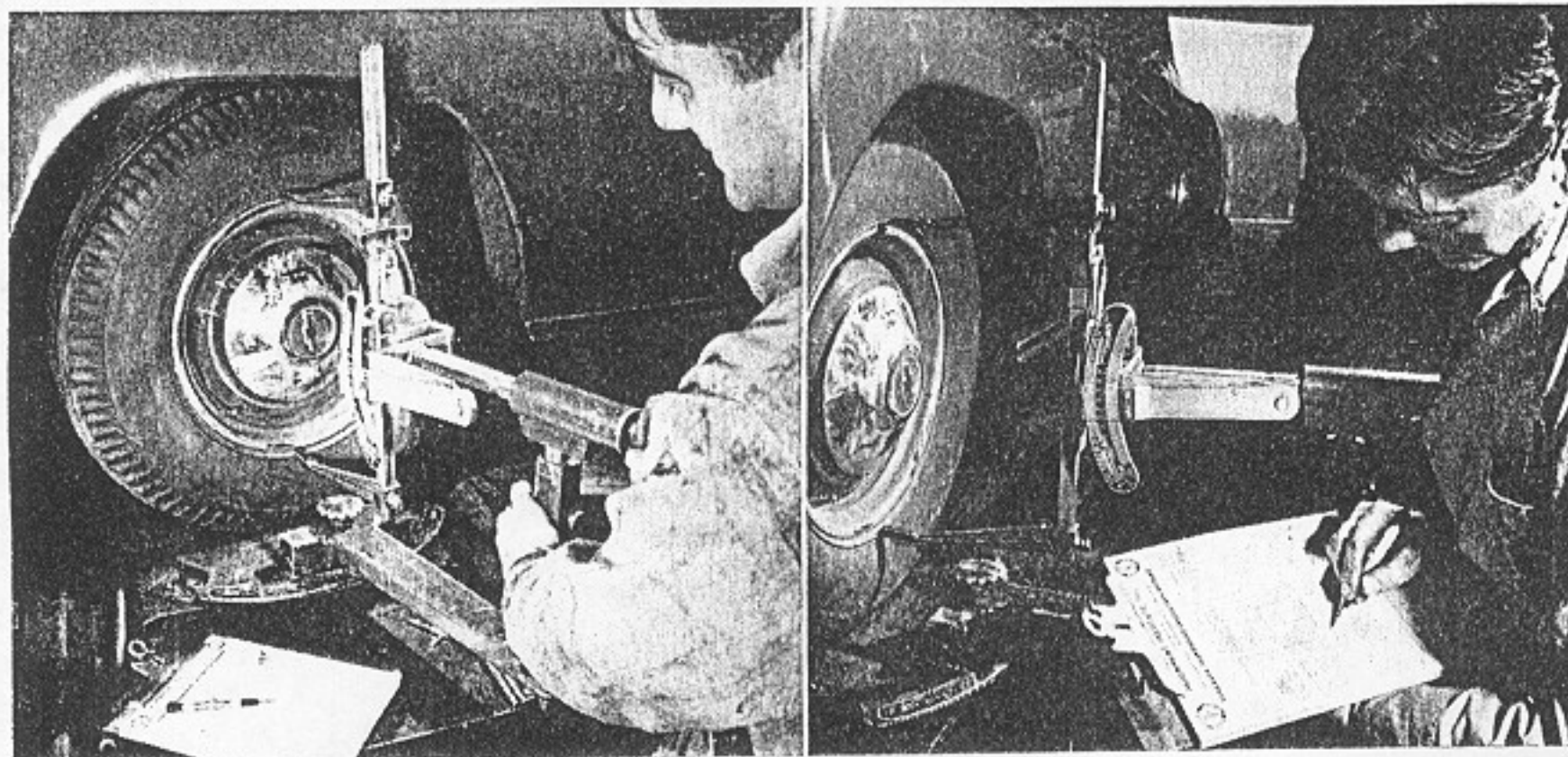


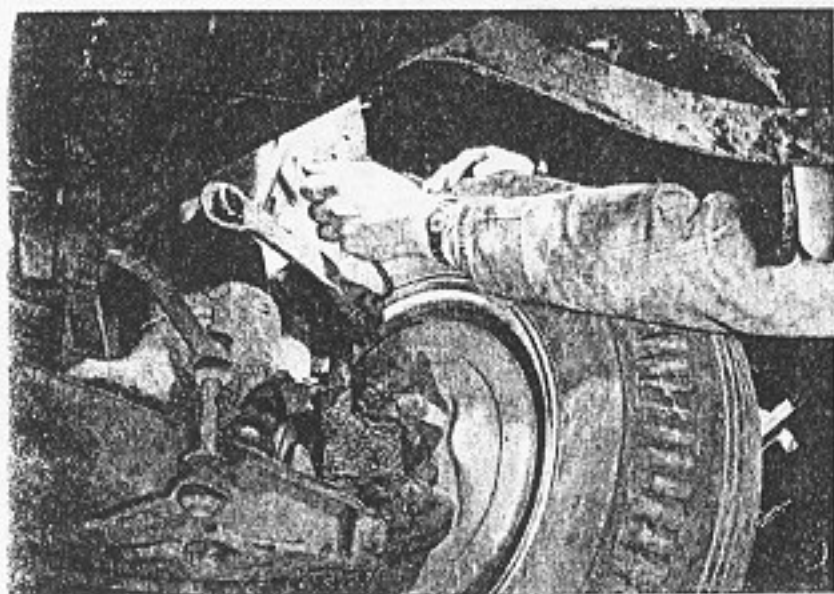
6 Kingpin and knee-action wear is even easier to detect if a pry bar is used. Both

wheels also are shaken to reveal play in tie rod, drag link, pitman arm and steering gear.

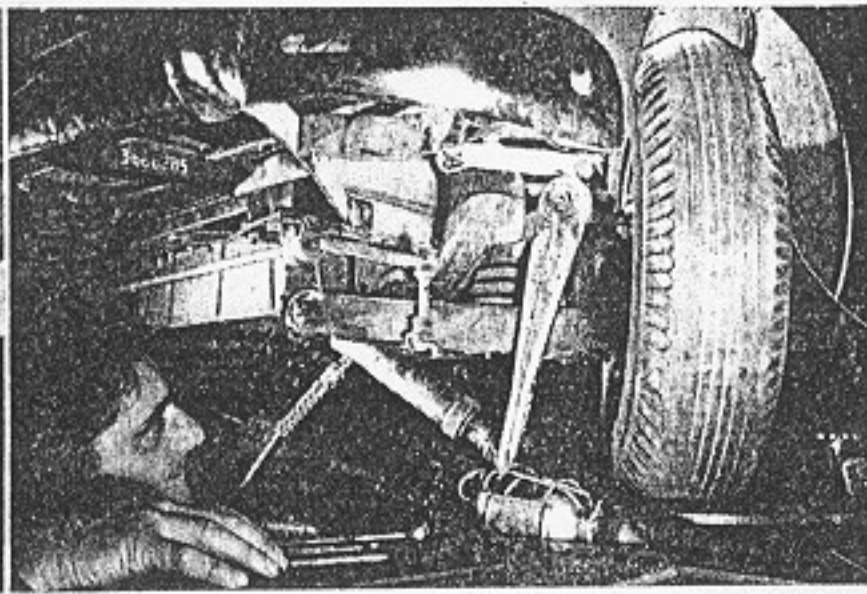
7 Actual alignment checks now begin. This gauge measures both caster and camber. For an explanation of these alignment terms, see the experiments following this article.

8 Angles are recorded on chart as the job progresses. Note that gauge points rest against rim edge—not on tire or wheel ring. Curved scale indicates both caster and camber.

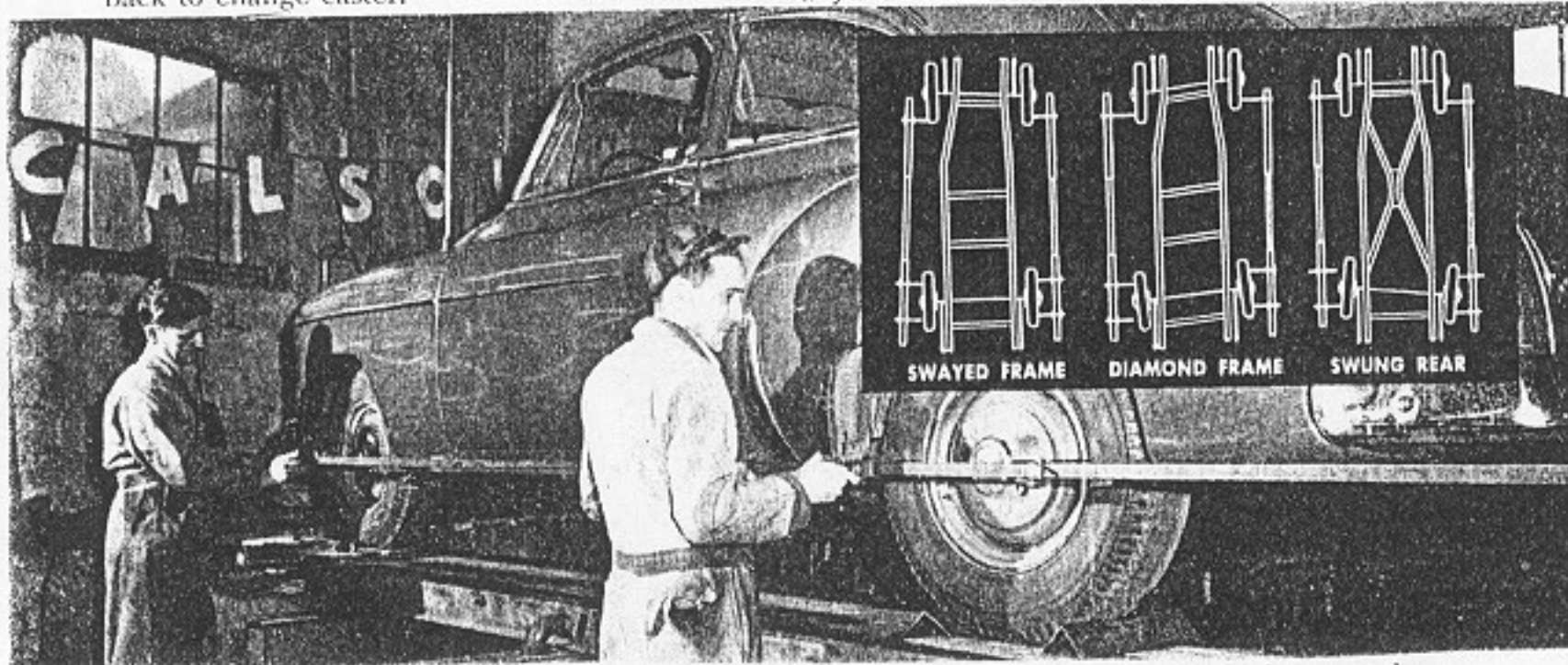




9 Camber is adjusted on this particular car by rotating eccentric upper pivot pin. It has socket for Allen wrench Nadworny is using. In this case, 180° rotation gives entire adjustment range. Same pin is threaded to move front and back to change caster.

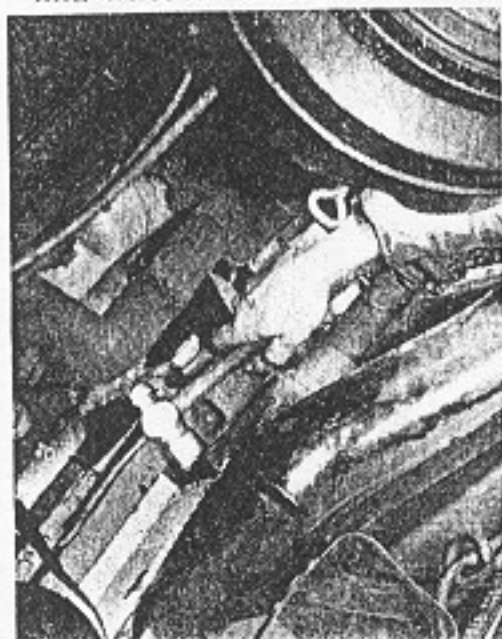


10 Hydraulic pressure from jack is used to bend knuckle for increase or decrease of camber if eccentric pin does not allow enough adjustment to give correct reading. The forged knuckle support can stand such bending without any ill effects.

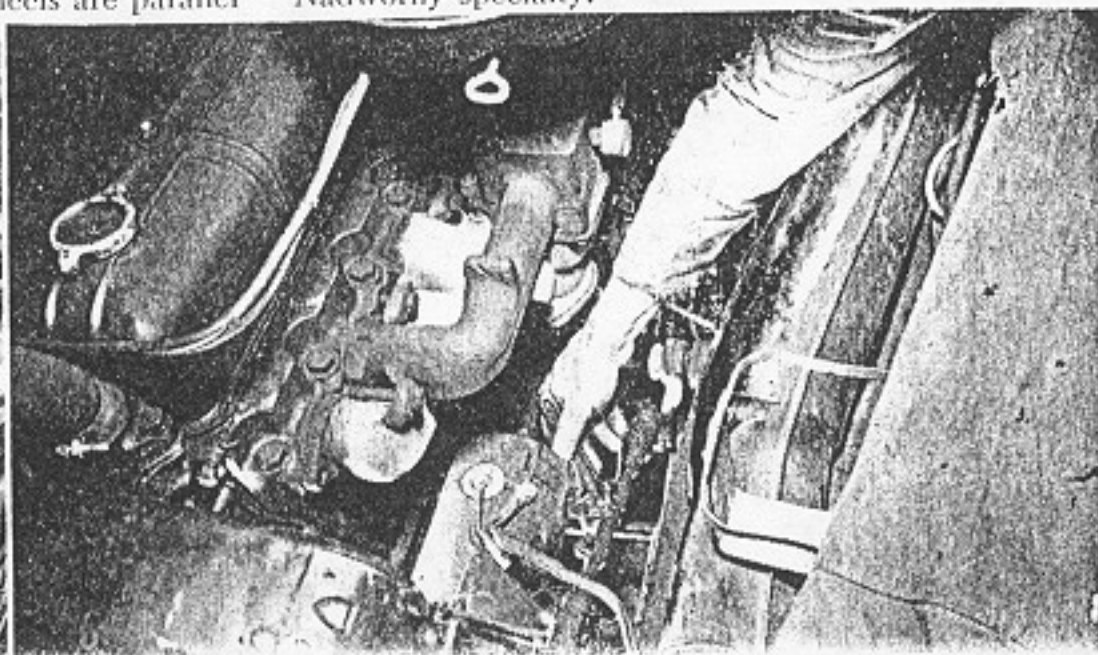


11 Rear wheels are checked, too. After front wheels are set absolutely straight ahead, tracking gauge is used on both sides of car to find whether front and back wheels are parallel

and same distance apart. Sketch shows tracking defects that gauge may reveal. Tolerance of only $\frac{1}{8}$ " is allowed. Frame straightening is also a Nadworny specialty.

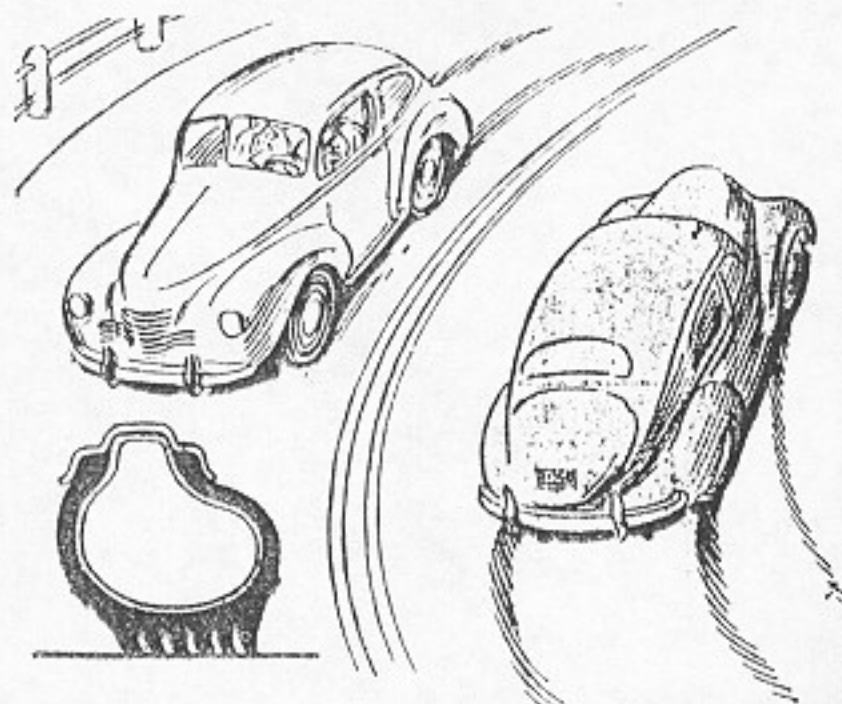


12 As final fine point, excess lash in the steering-gear mechanism is taken up by rotating an adjustment. This then is locked in position.

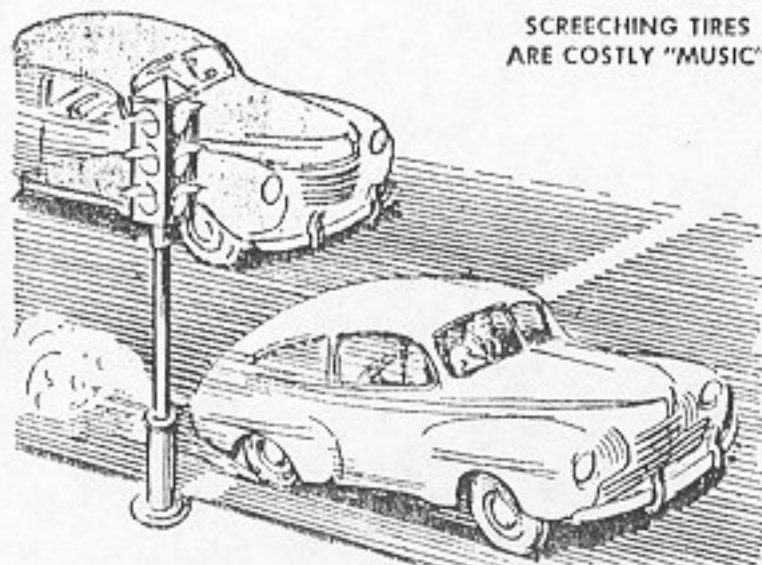
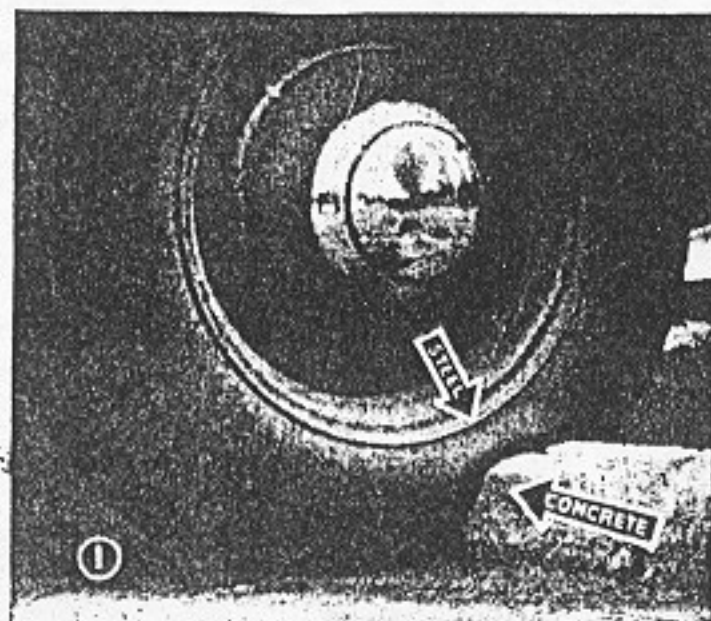


13 Drag link is adjusted to center steering wheel. With front wheels straight ahead, center bar of steering wheel should be horizontal. An uncentered wheel causes play in gearing. After a final check on alignment ramp and a road test, this car is ready for travel.

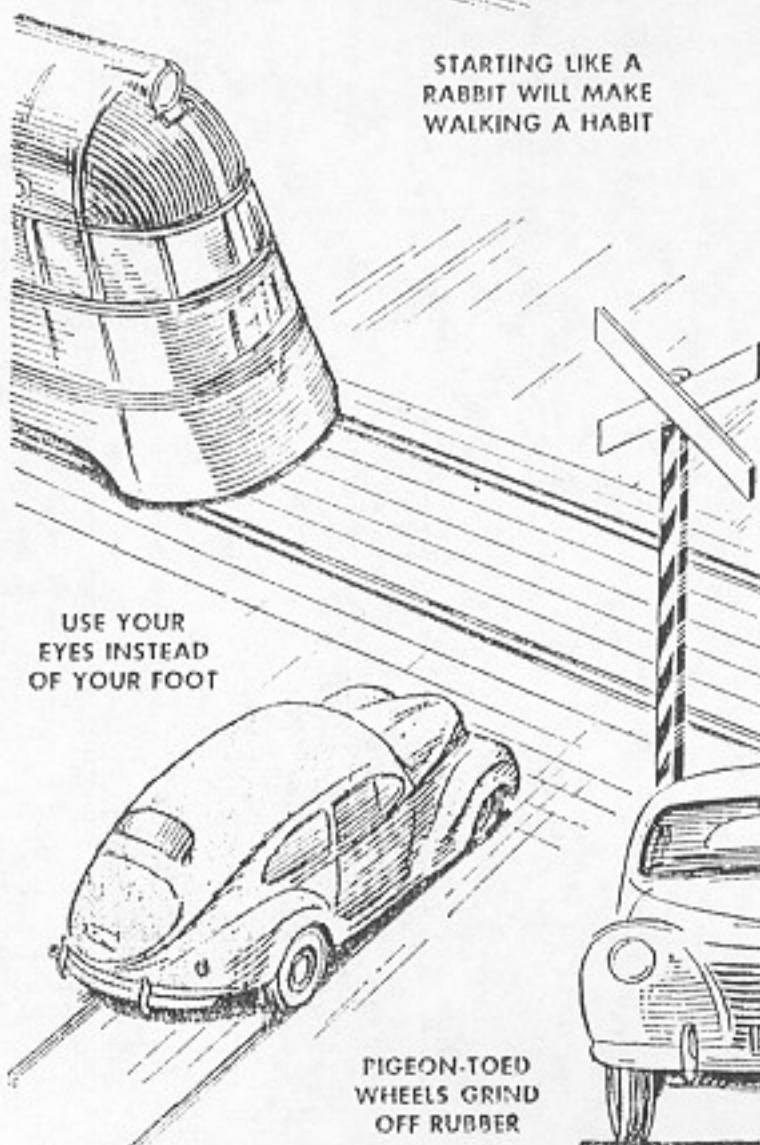
TIRE CARE



SCREECHING TIRES
ARE COSTLY "MUSIC"



STARTING LIKE A
RABBIT WILL MAKE
WALKING A HABIT

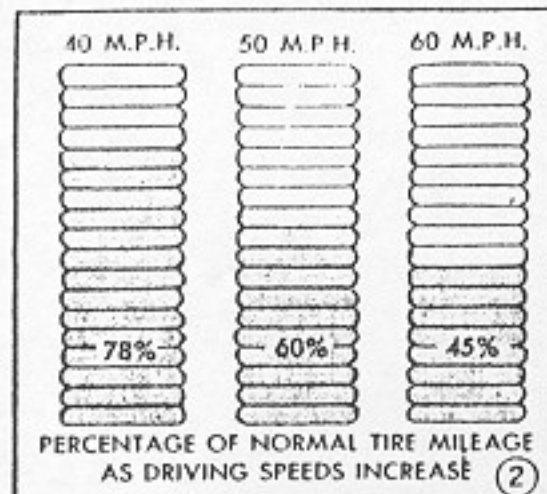


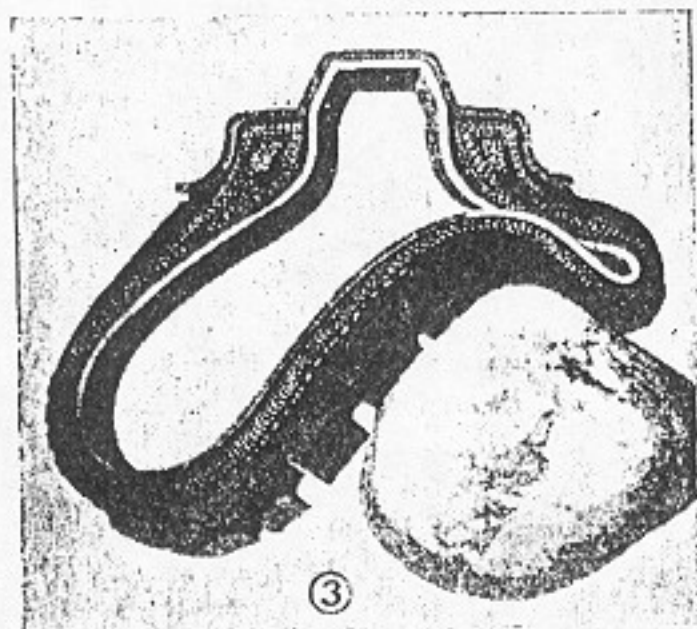
USE YOUR
EYES INSTEAD
OF YOUR FOOT

PIGEON-TOED
WHEELS GRIND
OFF RUBBER

MOST of us can prolong the life of our tires as much as 50 percent simply by being careful in our driving habits and by giving the tires the attention they should have. Yielding to the temptation of driving fast to reach a destination in a period of time that requires the speed of a streamliner literally tears mileage off your tires. Actually, tires wear 60 percent faster at 70 m.p.h. than they do at 50 m.p.h. because brakes must be applied more severely, slippage between tires and road is increased, and heat generated at high speeds softens the rubber and tends to separate the cords from it. Fig. 2 shows the percentage of tire wear at different speeds.

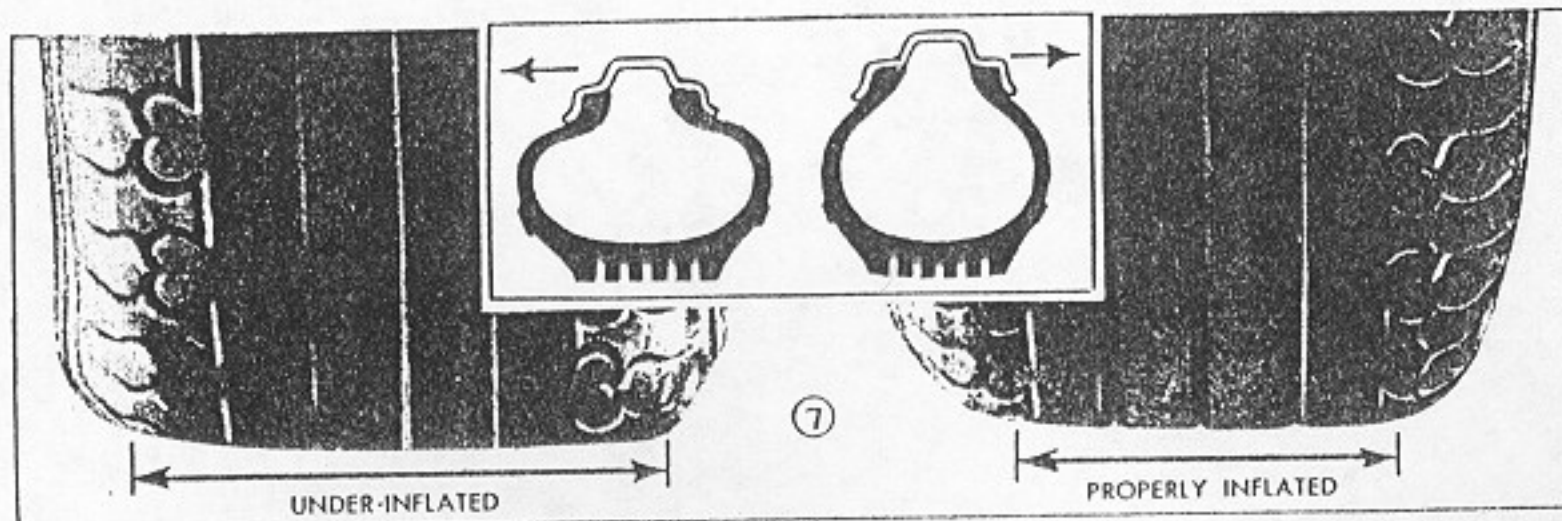
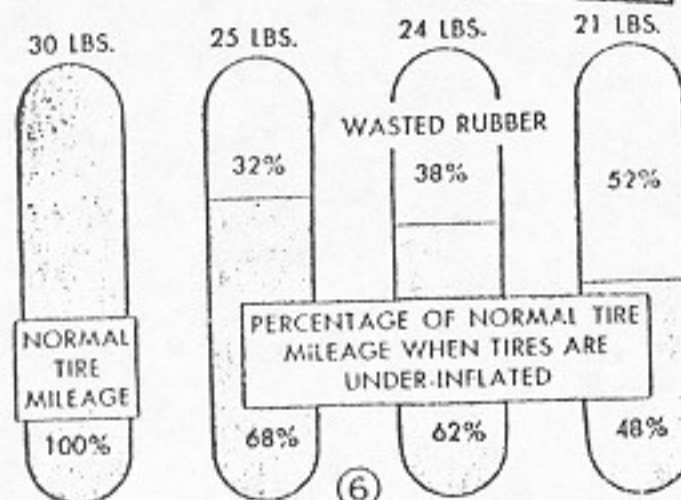
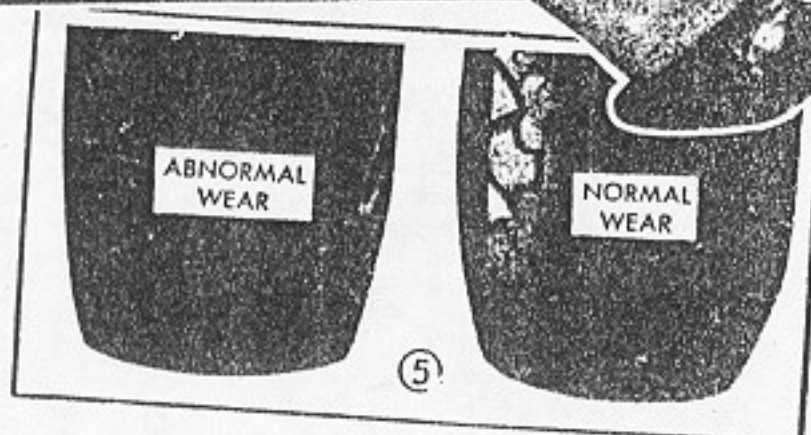
You wouldn't deliberately run a grinding wheel over your tires, but they are subjected to similar abrasive action when you take a curve too fast or when the rear wheels slip when making fast starts. Coasting up to known stops and trying to anticipate the unknown ones in plenty of time to avoid set-

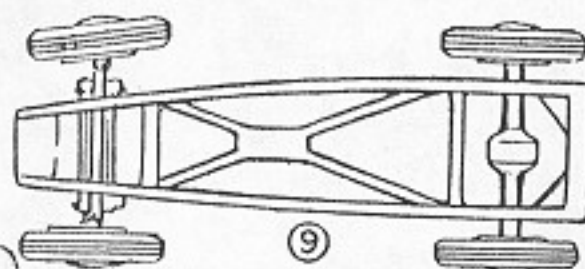




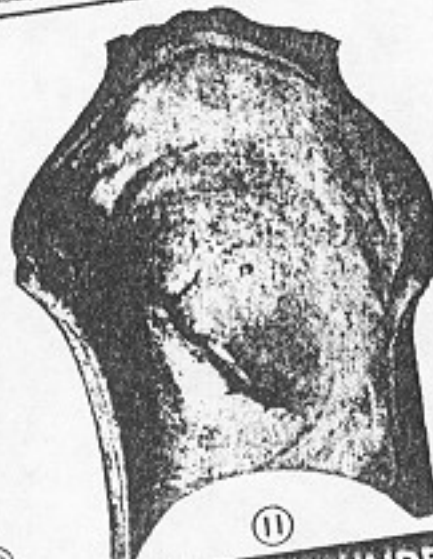
ting the brakes hard will add many miles to your tires. Also, avoid holes in the pavement and small objects lying on it, and be careful when you park to avoid hitting a curb, Fig. 1. Striking such obstacles pinches a tire, creasing it sharply and pressing it against the steel rim of the wheel, which is likely to break the fabric and cords, Fig. 3.

Probably the greatest enemy of long tire life is incorrect inflation, which can be avoided by making weekly or semi-weekly checks. Both the air and service for this are free and it takes only a few minutes of your time. Keep the pressure in your tires as recommended by the tire manufacturer. If you put in a pound or so too much, let it out, Fig. 4, because overinflation is just as bad as underinflation. While it's true that underinflated tires give a soft ride, they are very expensive cushions as the tread wears rapidly and the cords inside the tire tend to separate from the rubber as in Fig. 12. A glance at Figs. 5, 6 and 7 will show more results of underinflation. One tire manufacturer





claims that under average driving conditions a popular-size tire loses 2 lbs. of air a week. Such a tire, under-inflated 6 lbs., loses as much as 25 percent of its normal mileage. Aside from increased mileage resulting from regular attention to the tires, there is another ad-

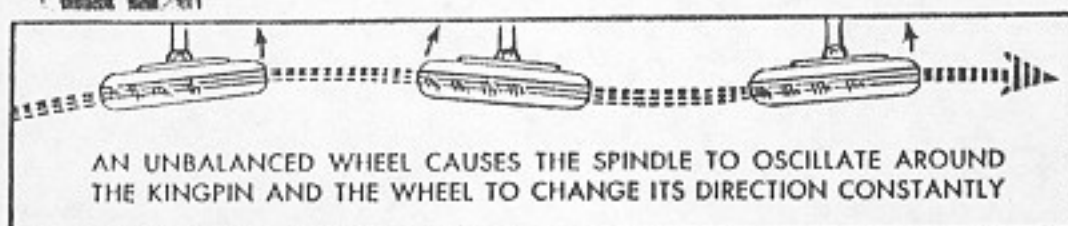
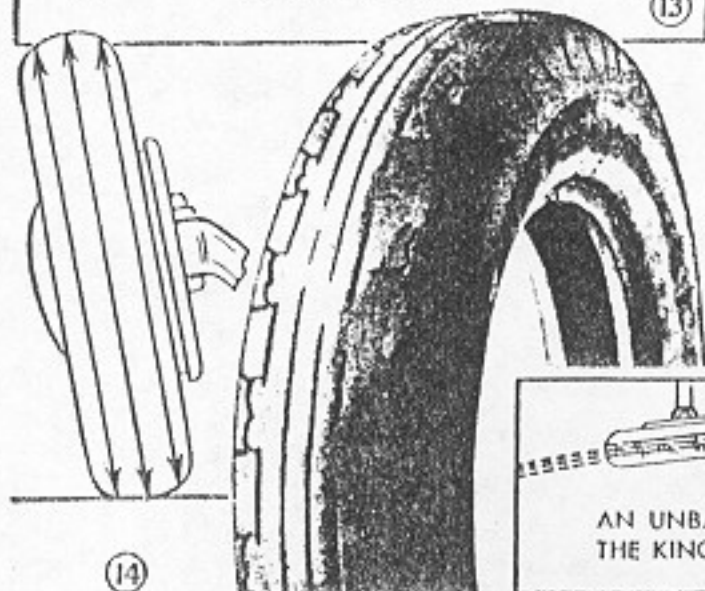


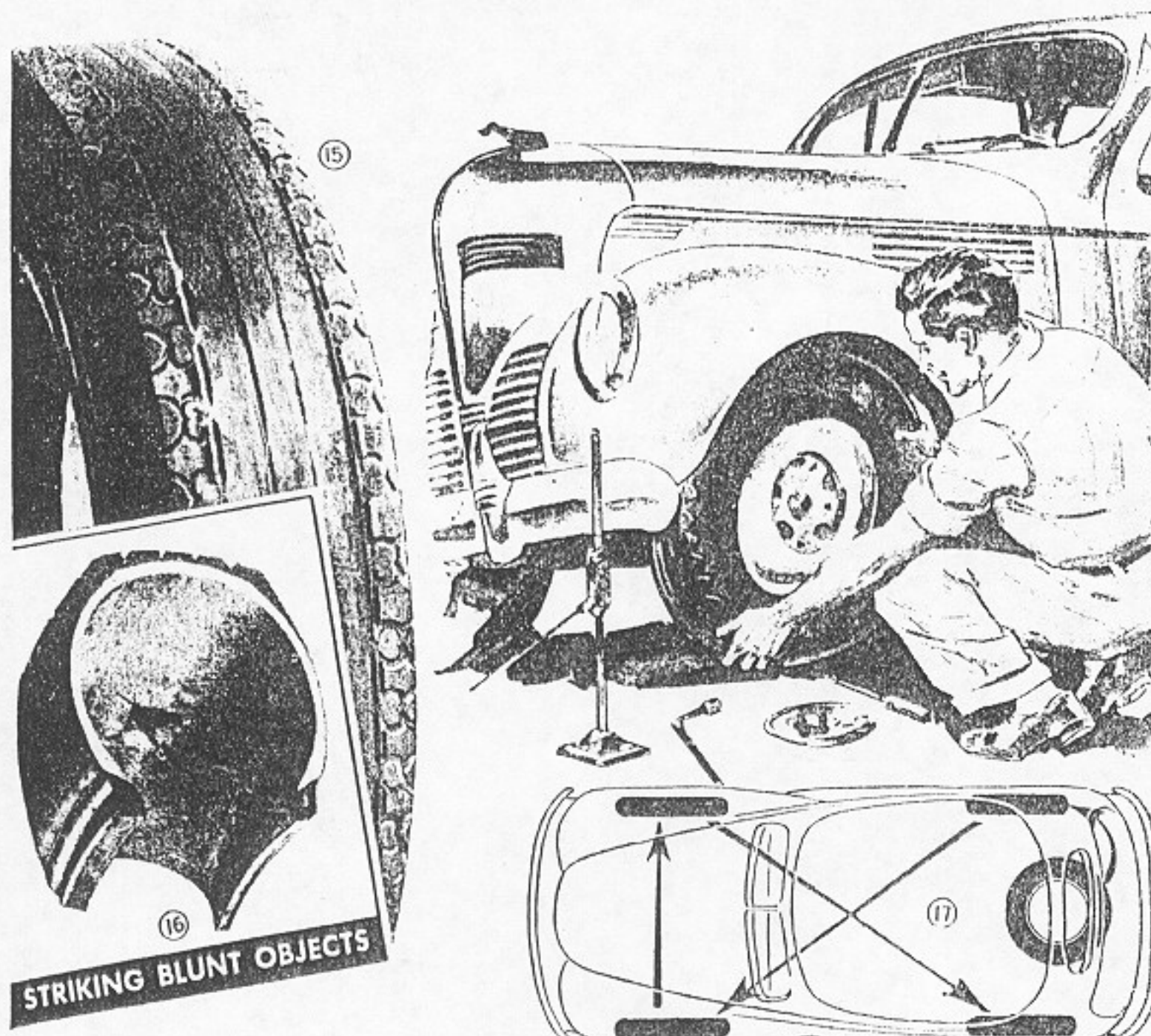
RESULTS OF NEGLECTED TREAD CUTS, UNDER-INFLATION AND



vantage in the fact that a slow leak can be detected when checking air pressure. With a 2-lb. pressure loss per week, a tire that has lost 6 to 8 lbs. is sure to have a leak. If a piece of glass or a nail is found and removed, Fig. 8, the cut should be cleaned and sealed with rubber putty or cement to prevent moisture from working into the cords. Cords act like wicks and hold moisture, causing them to rot and eventually break as in Fig. 11.

Blow-outs don't just happen, but the contributing causes often occur sometime previously. The cause may be a small tread cut, Fig. 10, that was neglected or was enlarged by over- or underinflation. Contacting a sharp object

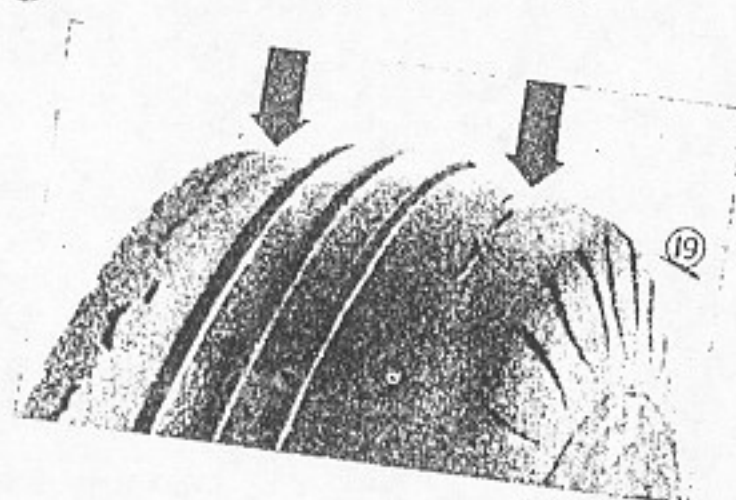
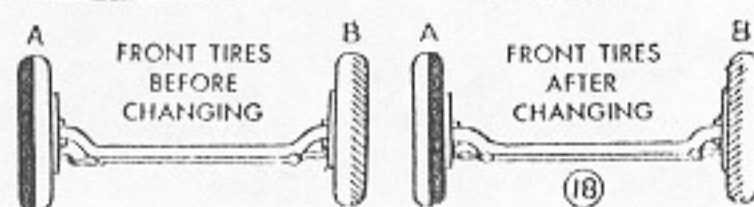




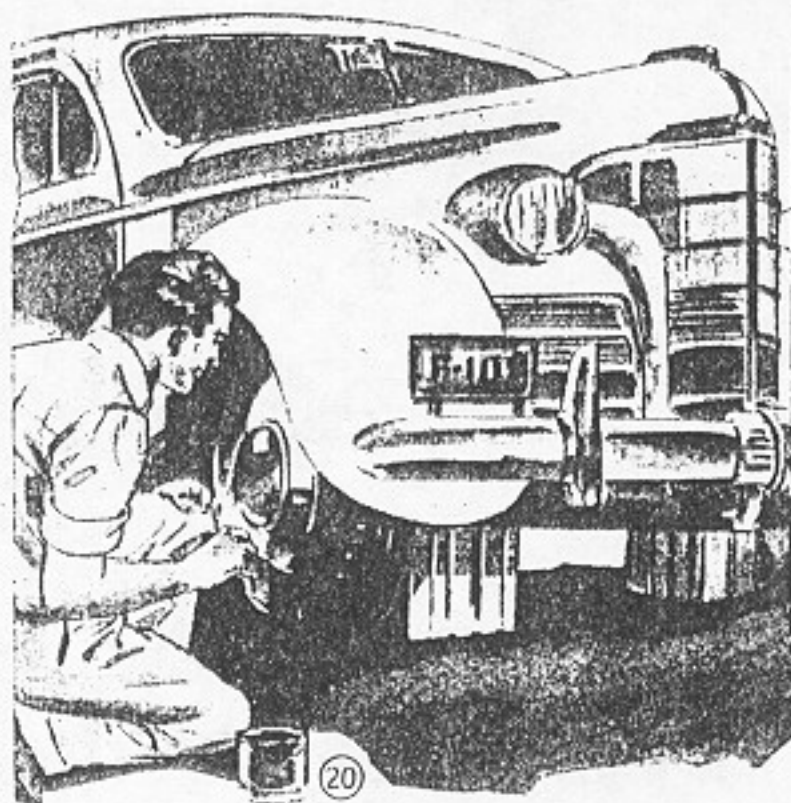
on the road does not always result in immediately visible damage but may break the cords as seen in Fig. 16, and this in turn may lead to a blowout. When your car is on a hoist being lubricated, it is a good idea to run the fingers over the tires. If the tire has been damaged in this way, there may be a slight bulge which may not be enough to see, but can be felt.

Misaligned wheels or improperly adjusted brakes take a high toll in tire life. A wheel that is $\frac{1}{2}$ in. out of alignment, drags sideways 87 ft. per mile. Fig. 15 shows what happens to the tire tread when this condition exists. Where front wheels do not track true, Fig. 9, one of them does the steering and the other one drags, which scuffs away the tread just like rubbing the tire with a file. If the edges on one side of the tread design are sharp or feathered, Fig. 13, when rubbing the hand across the tread, this condition indicates that the wheels are not in perfect alignment.

Does your car pull to one side when the brakes are applied? If so, you may be sure



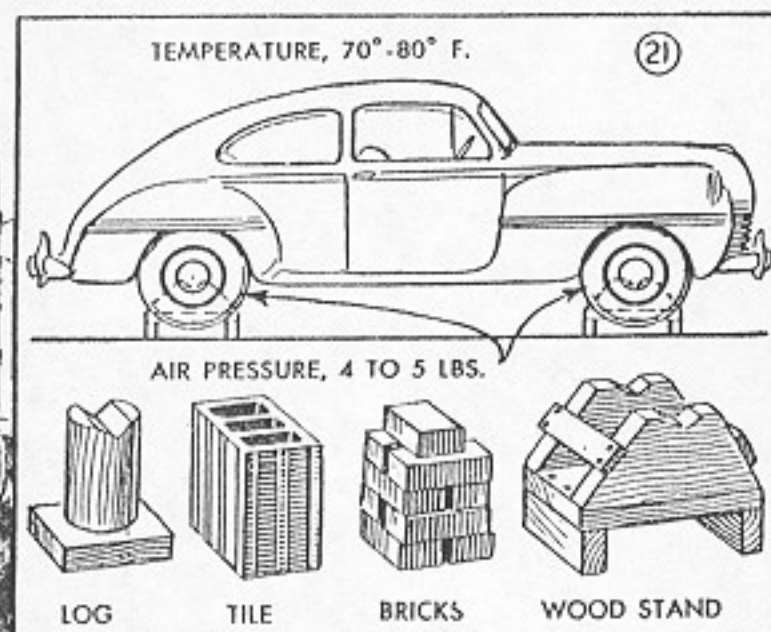
that brake adjustment is unequal, that most of the braking action is on one tire. On a test made by one manufacturer, the brakes were adjusted so that one wheel only would lock. At a speed of 80 m.p.h. the brakes were applied and held until the car stopped. When the tires were exam-



ined, the tread of the tire on the locked wheel was worn down to the breaker strip by this single operation alone. Even stepping hard on the brakes at 35 m.p.h. will scuff off enough tread to carry a car a full road mile.

"Heel and toe" wear may occur on any type of tread design, and to some extent is normal, though high-speed driving and excessive use of the brakes will accelerate the rate of wear. The remedy for this condition is to change the position of the tires on the car. Two ways of doing this are shown in Figs. 17 and 18.

The subject of wheel alignment includes far more than mere toe-in, one of the other important factors being that of camber, or the outward inclination of the wheel at the top. This is necessary for easy steering and maximum strength of the front system, but if present in excessive or unequal amounts, it creates tire trouble. In effect, due to the roundness of the tread, camber gives a tire several diameters, as indicated by the three arrows in Fig. 14. As the tire revolves as a unit, something must slip, and where the camber is excessive there will be tread wear. To minimize this, tires should be changed about as indicated by A and B in Fig. 18. To do this it is necessary to remove the tire from the wheel and turn it around. Rounding turns at excessive speed, especially with tires that are soft, creates a screeching sound. It is expensive "music," resulting in tread wear as indicated by the heavy arrows in Fig. 19. This can be offset to some extent, by changing the tires about as indicated in Fig. 17.

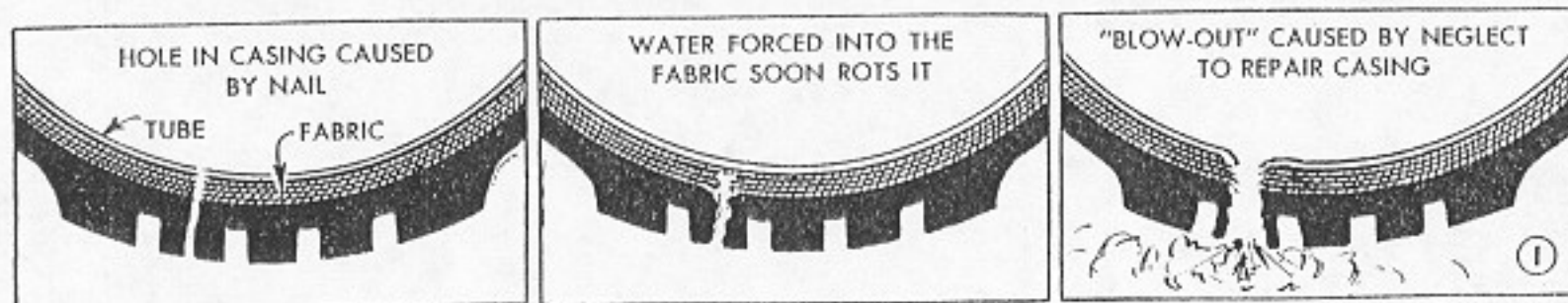


An unbalanced wheel may develop a spotty or cupped tread condition such as that shown in the photo of Fig. 14. Consequently, balancing of wheels should be considered as a regular maintenance item, for an unbalanced wheel, besides increasing tire wear, also causes considerable wear in the steering spindles, spring shackles and other chassis parts, thus contributing to a looseness which is conducive to further troubles. The disturbing forces produced by an unbalanced wheel increase tremendously with increase of speed. An assembly 1 oz. out of balance at the tread, will develop a 12-lb. vibrating force at 60 m.p.h. And, it is not uncommon to find wheels that are 6 or 12 oz. out of balance. While it is most important to keep the front wheels balanced, it is highly desirable to balance all wheels if the smoothest, most economical car operation is to be had. Alignment of wheels also should include an inspection of the rims, for a rim that is badly bent or rusted will injure the tube as well as the tire.

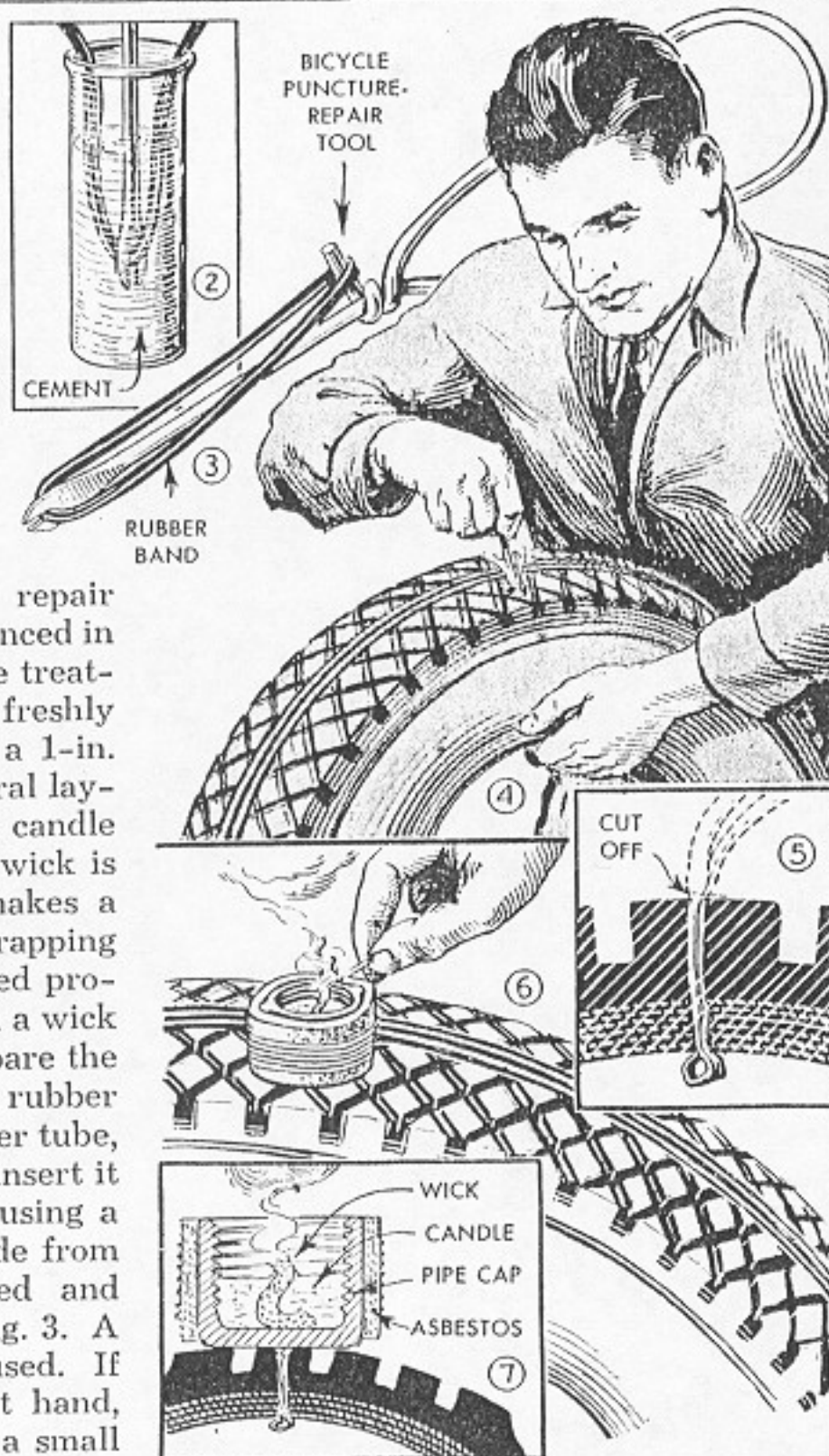
Removing Tires From Safety Rims

It is not such a difficult job to remove a tire from a safety rim if you go at it in the right way. Just stand with the heels on the tire at about the edge of the tread or white side walls and roll the bead out of the safety groove. This cannot be done when the heel is placed too close to the edge of the wheel. By using this method of breaking the bead from the safety groove, you can remove the tire in just a few minutes.

Vulcanize Small Punctures to Make Tires Last



Don't just patch the inner tube when you puncture a tire, but also seal the hole in the casing immediately. If this is not done, water coming in through the hole gradually rots the fabric and causes a weak spot. As the weakened area increases, a blowout results sooner or later as illustrated in Fig. 1. The best way to seal the puncture is to vulcanize it. Anyone can do this with a simple spot vulcanizer such as shown in Fig. 7. However, if the puncture is an old one and the fabric has started to rot, the repair should be left to a mechanic experienced in vulcanizing, as the hole will require treatment different from that of one freshly made. The vulcanizer consists of a 1-in. pipe cap that is wrapped with several layers of asbestos and half filled with candle wax or light motor oil in which a wick is inserted. A piece of sash cord makes a good wick. If this is unavailable, wrapping cord or similar material can be used provided it is bundled and tied to form a wick at least $\frac{3}{16}$ in. in diameter. To prepare the hole, first clean it thoroughly, dip a rubber band, or a strip cut from an old inner tube, in vulcanizing cement, Fig. 2, and insert it into the hole as in Figs. 4 and 5, using a bicycle tire-repair tool or one made from a length of heavy wire flattened and notched at the end as shown in Fig. 3. A long slender nail may even be used. If there is no vulcanizing cement at hand, you can make some by shredding a small piece of tube-patching rubber and soaking it in gasoline until it swells and softens. After inserting the rubber band in the hole, cut off the projecting ends inside and outside the casing. Now, with the casing supported in a vertical position, center the vulcanizer over the hole, using a screen-door spring to hold it tightly against the tire. Fasten one end of the spring to a harness ring that is slightly smaller than the diameter of the vulcanizer. Place the ring



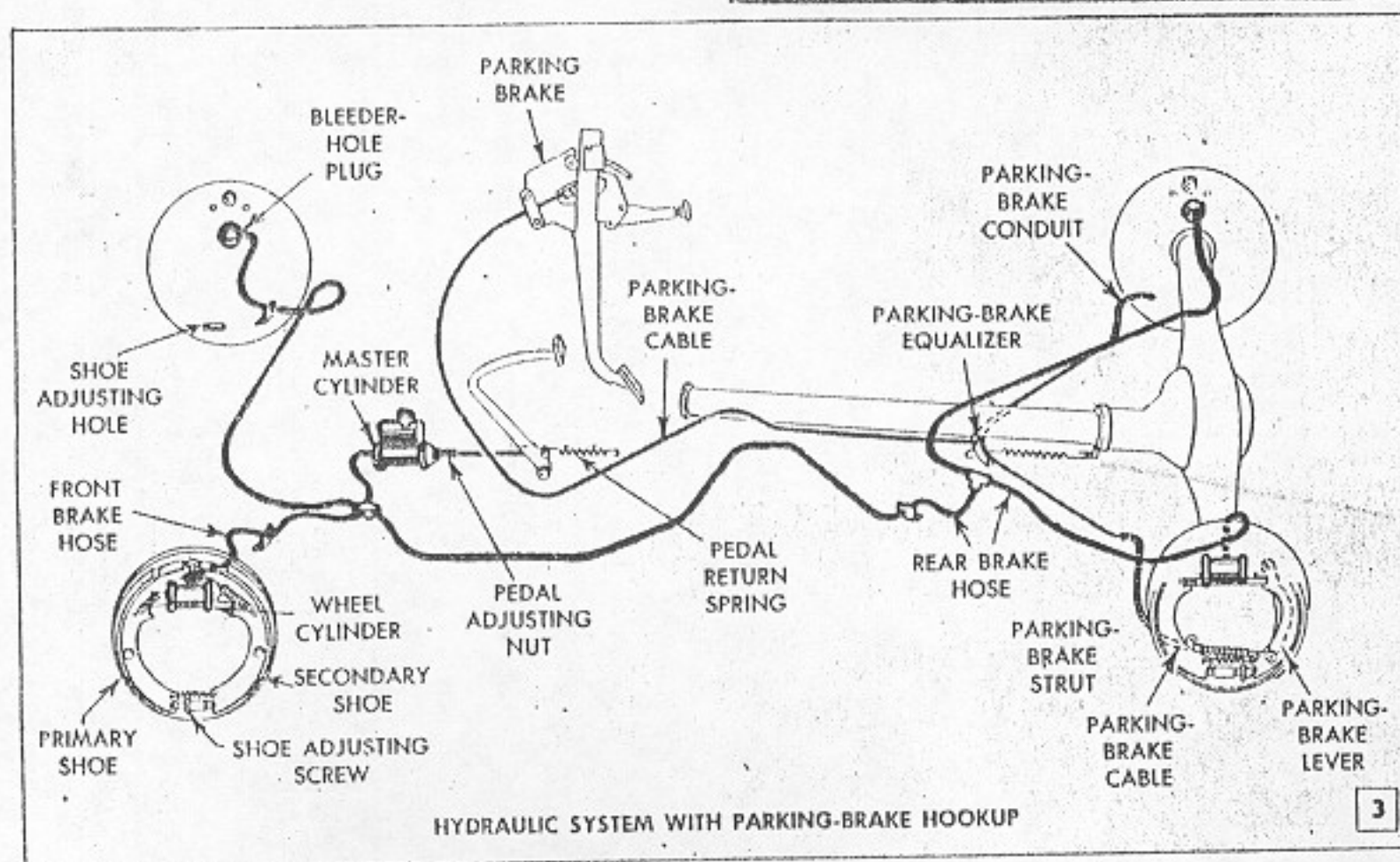
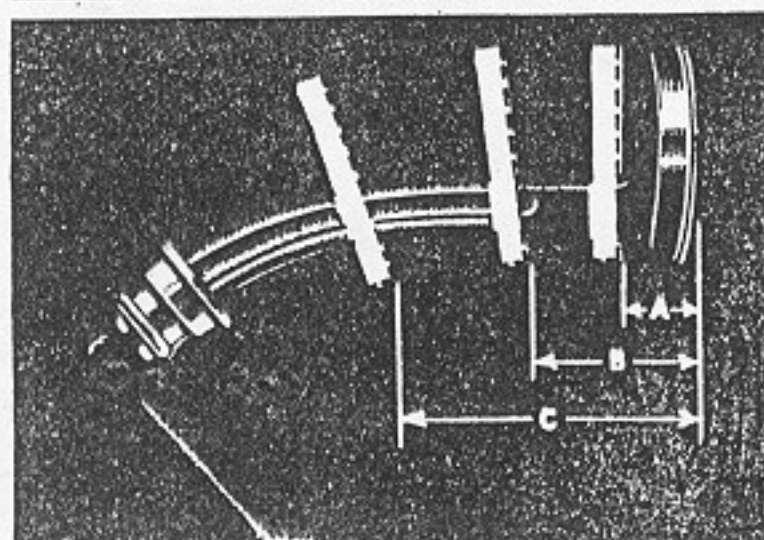
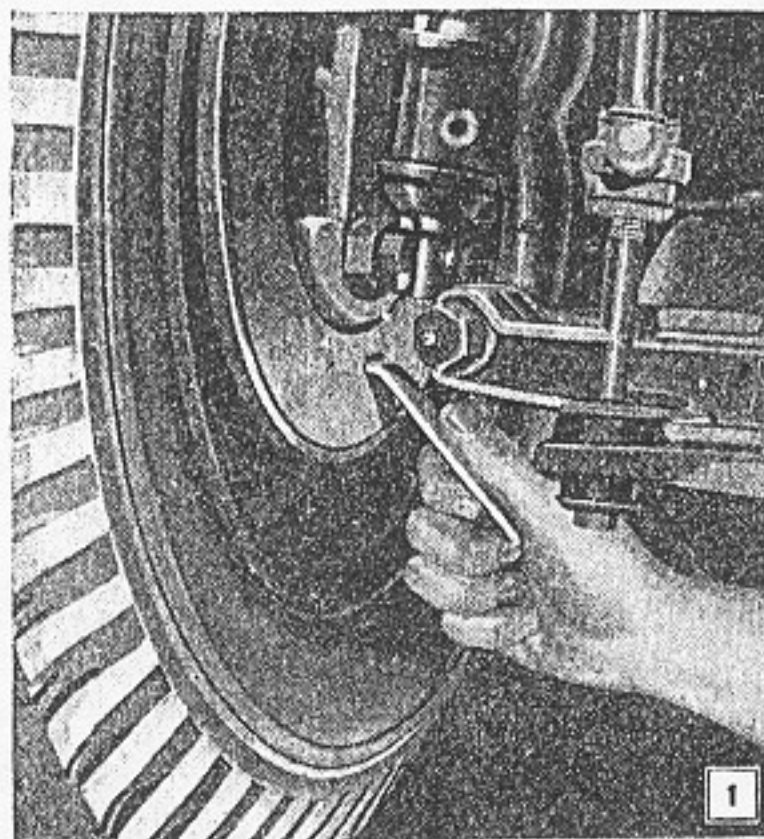
on top of it, bring the spring around the casing and then fasten the other end to the ring, thus causing the spring to pull down on the vulcanizer. Put three or four drops of rubber cement on the end of the wick to make it burn rapidly and ignite it as shown in Fig. 6. Wait about 10 to 15 min. after the wax or oil has been burned before removing the vulcanizer.

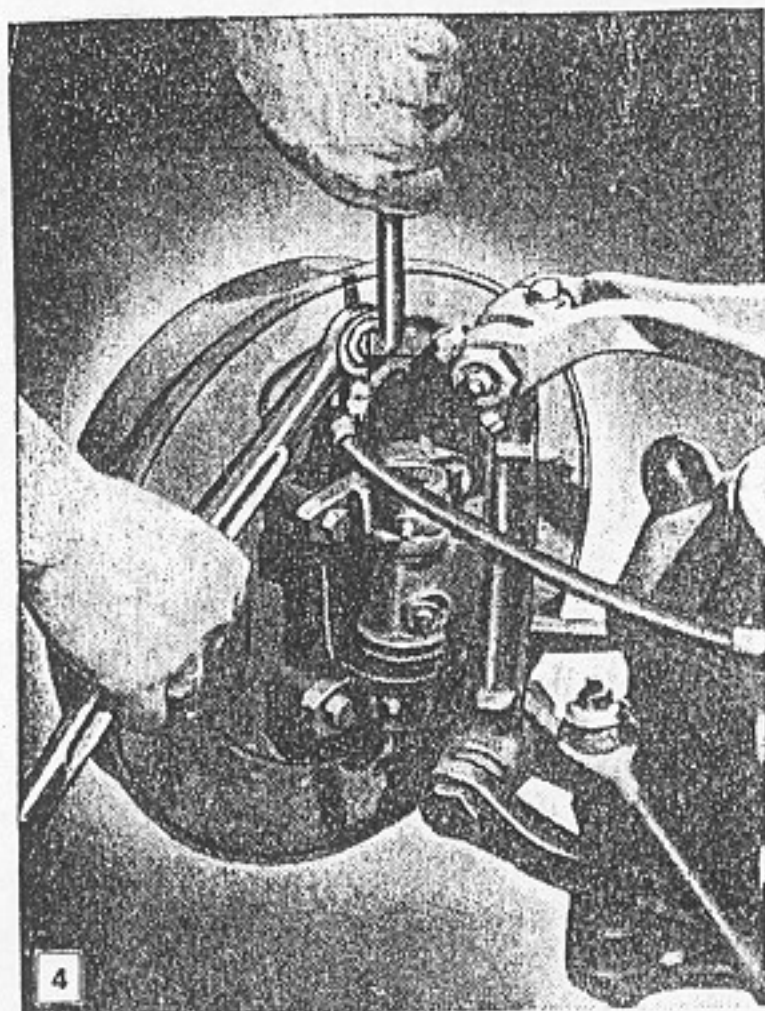
—A. L. Murray, Auburn, Ind.

CAR BRAKES

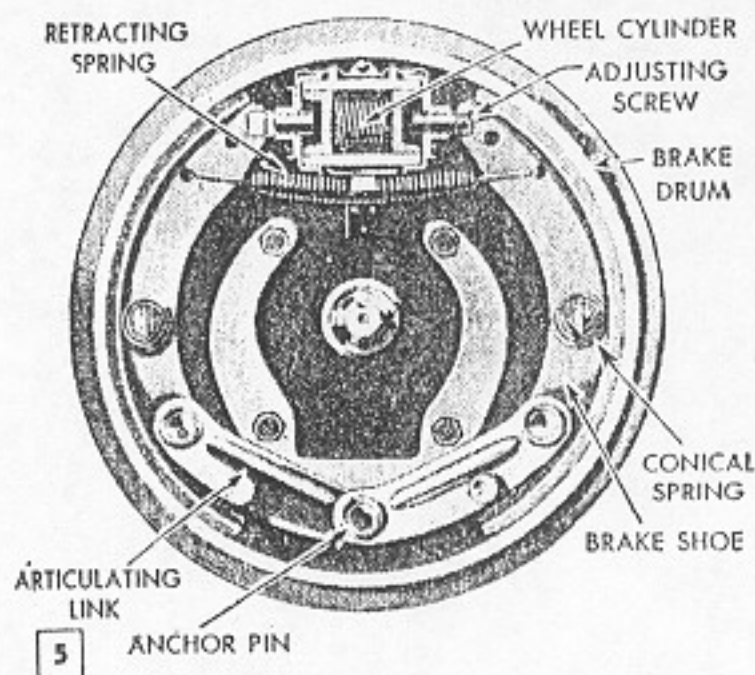
MODERN car-braking systems have been so simplified and standardized in construction that any car owner who likes to tinker can easily make ordinary repairs and adjustments himself. A simple adjustment of one or more of the four braking units, Fig. 1, renewal of shoes, adding fluid or bleeding air out of the system are usually all that is necessary. The most common symptoms of defects in the system are brakes that squeal on application, a "soft" pedal or a pedal that requires pumping in order to make a quick stop. Operation of the hydraulic service brake is quite simple and the parts are easily reached for servicing. When the brake pedal is depressed, a piston in the main, or master, cylinder, Fig. 7, exerts pressure on the fluid in the brake lines. This transfers an equalized pressure to pistons in each of the wheel cylinders, Figs. 3, 5 and 6. Each wheel cylinder contains two pistons, the purpose of the two being to distribute hydraulic pressure equally to the two brake shoes in each braking unit. As the pedal is released, the pressure is relieved and the brake-shoe retracting springs release the shoes from contact with the brake drums and, at the same time, force the pistons of the wheel cylinder inward. This movement forces fluid out of the cylinders and back into the brake lines.

Before servicing the brakes, check the

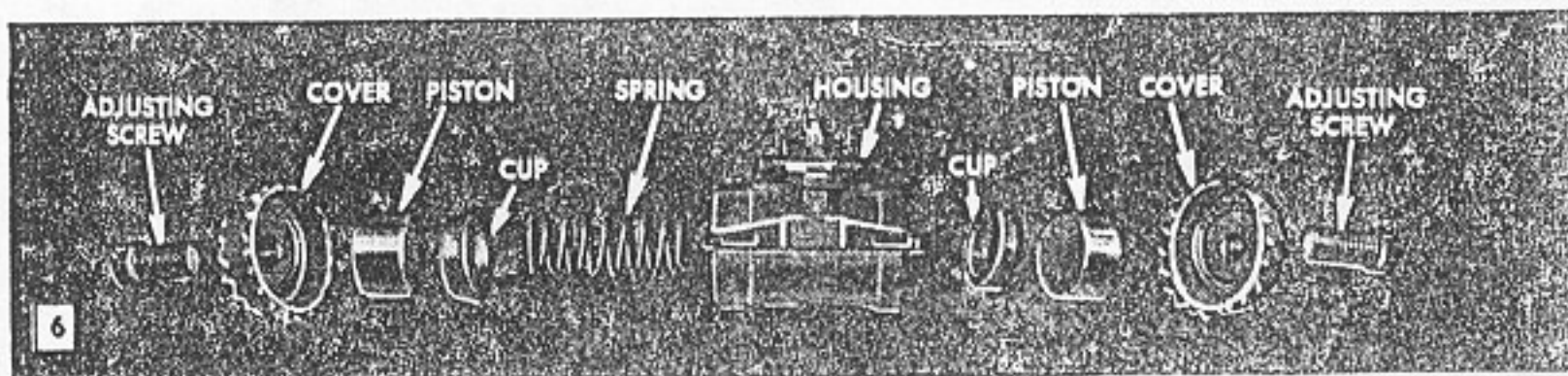




When new brake shoes are installed at the time of servicing, it's necessary to adjust anchor bolts. Although methods vary with different makes of brakes, the method shown above is typical of regular procedure

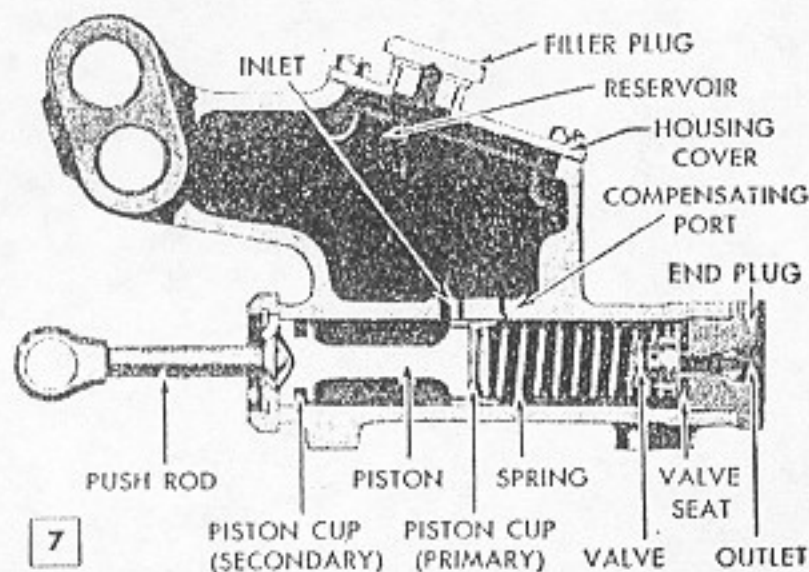


Sectional view, above, shows the hydraulic wheel cylinder and other parts of the brake unit. Below is a pull-apart view of the wheel cylinder, showing the various parts. Shown at the right is the master cylinder



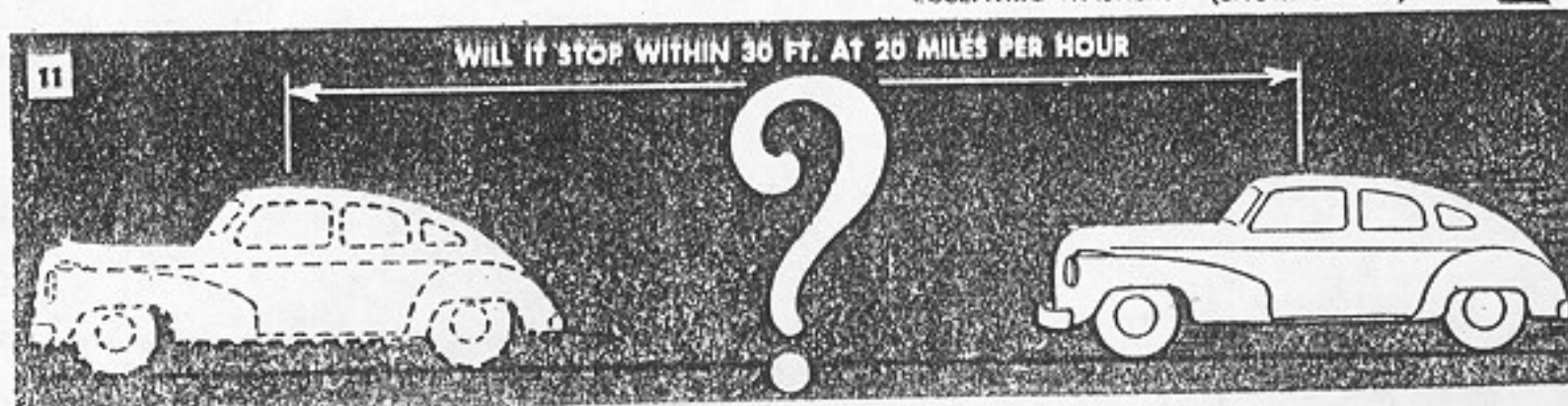
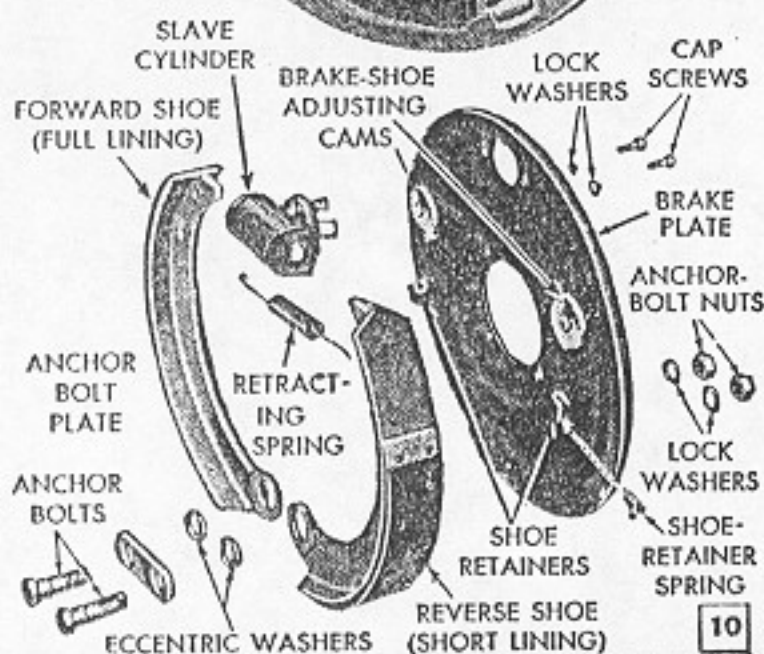
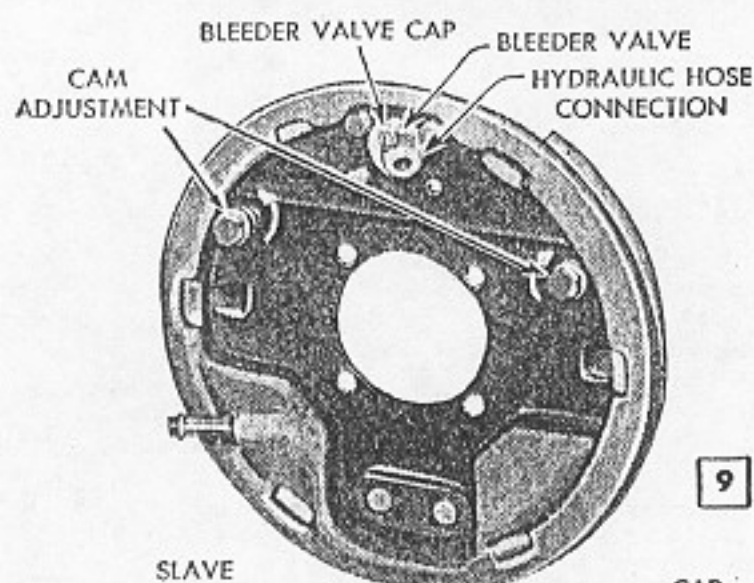
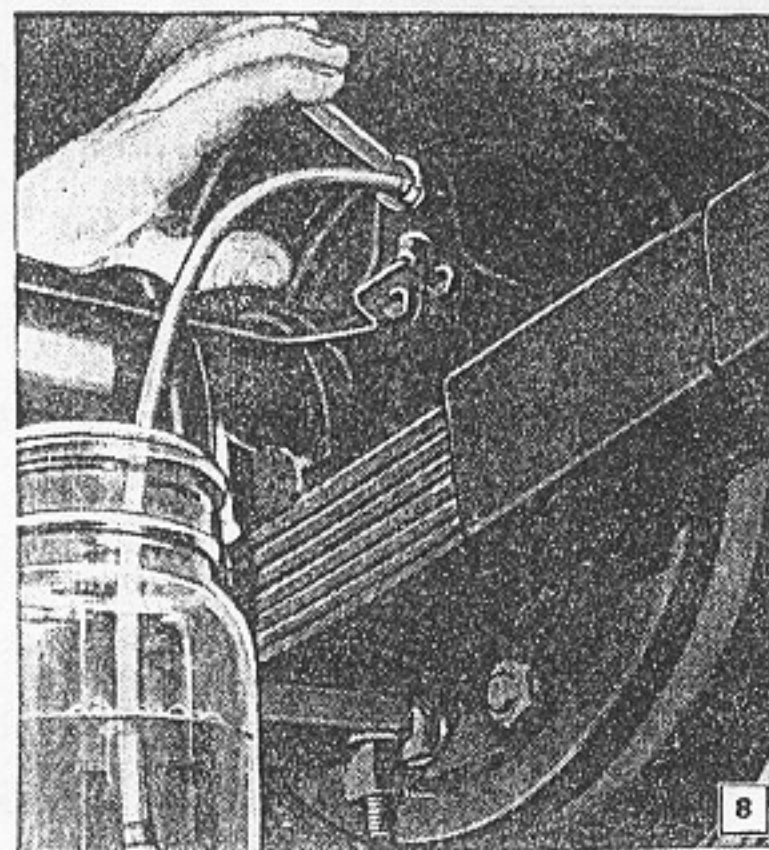
pedal for free movement and toeboard clearance. There should be from $\frac{1}{4}$ to $\frac{1}{2}$ in. of free movement, A in Fig. 2. Full braking pressure should be available between the positions B and C. A soft, spongy pedal can mean that there is air or gas in the system or insufficient fluid. Check the fluid level in the master cylinder, add fluid if necessary and then, before bleeding the system, examine the lines carefully for leaks. In bleeding the system to remove air, it is a common rule that the longest pipe line should be bled first. Remove the bleeder valve screw, Figs. 8, 9 and 10. Then attach the bleeder drain, Fig. 8, being careful to keep the end of the bleeder drain hose below the level of fluid in the jar. Unscrew the bleeder valve one-half to three-quarters turn, depress the foot pedal by hand and then allow it to return slowly. Air in the system will show as bubbles on the surface of the fluid in the glass jar. Continue movement of the pedal until bubbles cease to appear. Then tighten the bleeder valve, remove the drain hose and replace and tighten the screw at the bleeder valve.

To adjust the brake shoes, jack up the car and block the axles so that the wheels can be turned freely. Disconnect emergency-brake pull rods and remove the adjusting-hole covers from the flange plates. On one common type of brake, these holes are located at the bottom of the flange plate as in Fig. 1. Insert a flat tool or a screwdriver in the hole. The end of the tool should engage the lugs on the adjusting cover or star wheel. Lift up on



the adjusting tool to turn the star wheel to the right. Continue the adjustment on both star wheels until the brake shoes drag slightly when the road wheel is turned. Then back off the star wheel the required number of notches to give the brakes the proper running clearance. The service manual gives the proper number of notches to back the adjusting mechanism to get the correct clearance. The emergency or parking brake should be adjusted each time the service brakes are adjusted and, on some cars, it is necessary to adjust the parking brake before backing off the star wheels in the rear brakes. When new brake shoes have been installed at the time of servicing the brakes, it will be necessary to adjust all anchor bolts, Figs. 4 and 10. Although the methods will vary with different cars and makes of brakes, Fig. 4 shows the typical procedure in making this adjustment. After servicing the brakes, be sure that there is sufficient brake fluid in the master cylinder. The recommendations generally specify that it should be nearly full. Use only the brake fluid specified by the manufacturer of the car. On some late-model postwar cars, the brakes are of the self-centering, self-adjusting type. Under normal wear, this brake will not require servicing until replacement of the brake shoes is necessary. The brake automatically adjusts itself to compensate for each .005 in. of wear on the linings, keeping the running clearance always approximately the same.

To check performance of the brakes under the average driving conditions, road-test the car after the servicing has been completed. On dry, smooth concrete, the brakes should stop the car easily within a distance of 30 ft. at a speed of 20 m.p.h., Fig. 11, assuming, of course, that the tires are in good condition and have sufficient tread to grip the surface of the road effectively. This is a fair measure of brake efficiency but it is well to remember that other mechanical defects will affect good braking. Incorrect wheel alignment and wheels out of balance, worn tires, underinflation or overinflation of the tires, and worn wheel bearings are defects to look for if carefully serviced brakes do not give good performance under test.





How to Adjust Your Brakes

As the linings wear, they must be pulled closer to the shoes. This is an easy hour-or-so job.

By E. F. Lindsley

DOES your brake pedal go down almost to the mat before your car comes to a stop? Do you have to pump the pedal to build up a comfortable pedal clearance? If your car is fairly new or the linings are new, the chances are that a minor adjustment job will clear up the trouble. This is an easy job that you can do in an hour or so some Saturday morning.

The master cylinder for a hydraulic-brake system is a simple plunger pump. For a given amount of pedal travel you

pump a specific amount of fluid to each of the four wheels. If the wheel cylinders must push the brake shoes a good distance to contact the drum, the pedal must travel farther to force sufficient fluid down there. The idea is to adjust the shoes so that they barely clear the drums and need only a slight nudge to jack them out into contact.

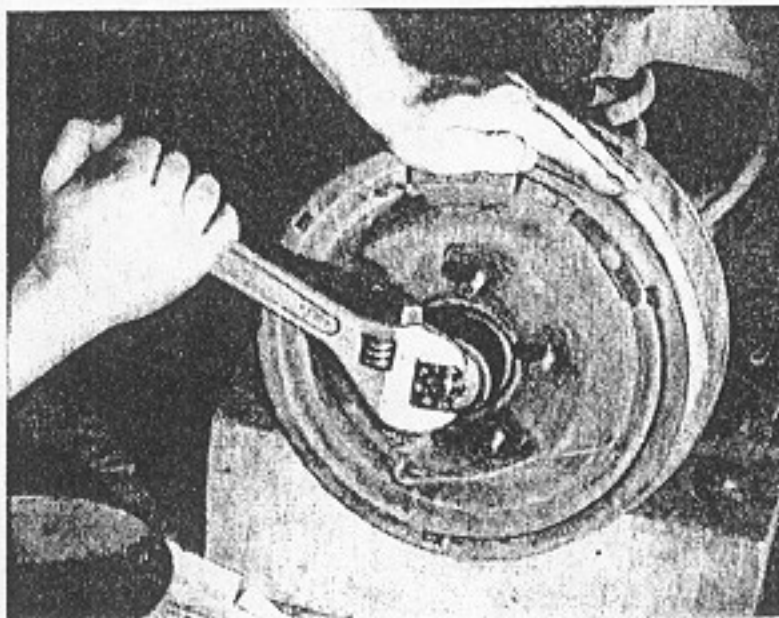
This is the big difference between a minor and major brake adjustment. A major adjustment sets up basic relationships of the brake anchor pins to give certain design clearances between the brake-shoe heel and toe, and between front and rear shoes and the brake drum. Once this is established by an expert, at the factory or in a good brake shop, even an amateur can make routine minor ad-

justments during the life of the linings.

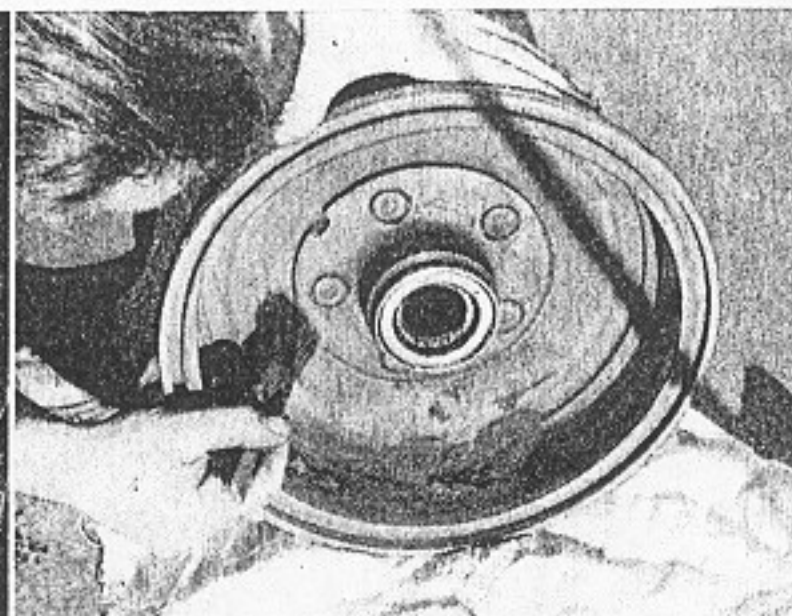
The star-wheel adjustment system is one of the three main types of adjusting mechanisms. This type is easily spotted by the small elongated dust cover of rubber or metal that covers the wheel. Pry off this cover and you find a notched wheel an inch or so in diameter (you may need a light to see it). This wheel may be at top or bottom of the back-plate. Some brakes have two wheels.

Ordinarily a screwdriver thrust into the notches and levered against the side of the slot will turn the wheel. Bending a slight dogleg in the screwdriver will sometimes make it easier. You might also try a beverage-can opener with the end ground square.

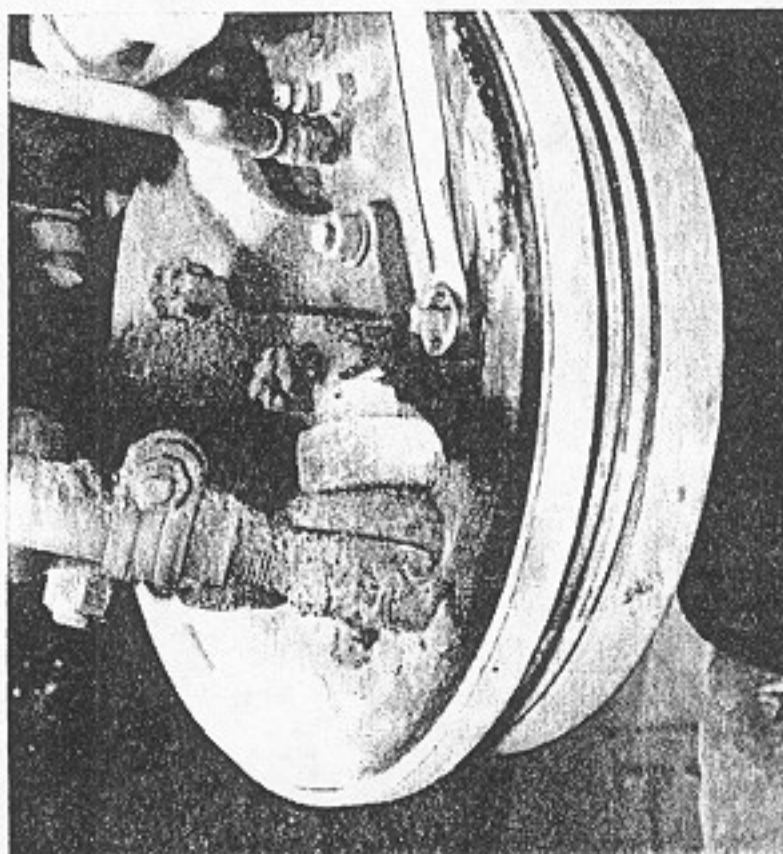
A pair of eccentrics or cams are provided for adjustment in some other cars. The business ends project from the backing plate. They are easily attacked after



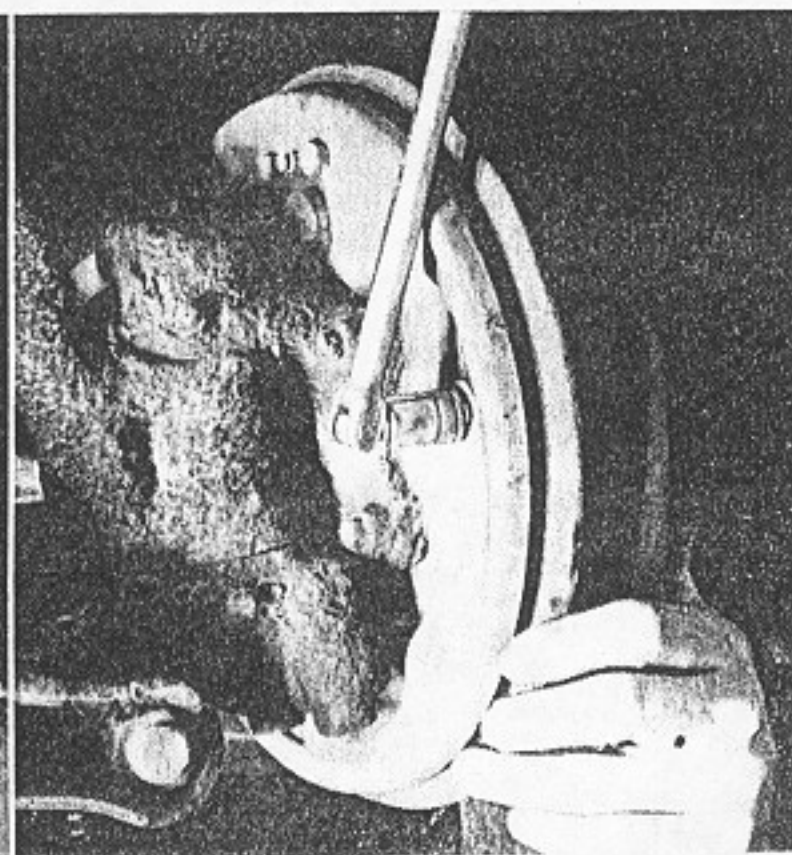
PULLING THE WHEEL isn't necessary when you do a minor brake-adjustment job, but it offers a good chance to check bearings, linings and possible hydraulic-fluid or grease leakage. Be sure to tighten the bearing nut properly.



AN OLD PAINTBRUSH does a fine job of cleaning dust from brakes. Use it to sweep out the drum as well as areas around the shoes, wheel cylinder and the other working parts. But don't use solvent. It might damage the lining.



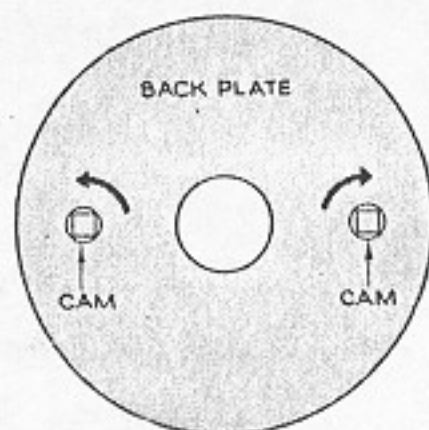
LOOSEN ECCENTRIC LOCK NUT about one turn as first step in eccentric adjustment. Flat stem is for adjustment and for holding screw when lock nut is retightened. If cam stud refuses to



budge and a snug square socket isn't handy, try the rig shown at right. Invert a $\frac{3}{8}$ " drive socket and use another socket on a short hex bolt with a jam nut as the coupler.

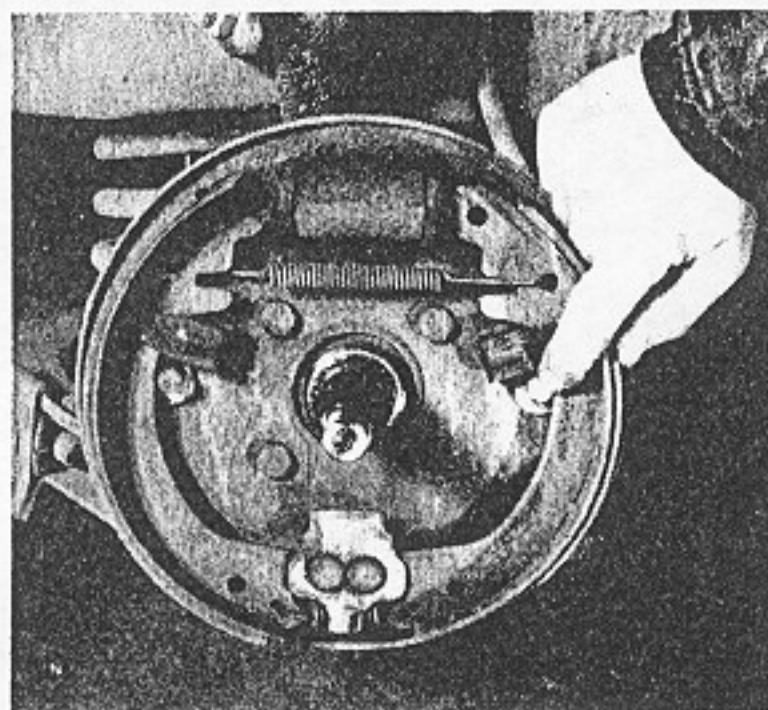
Three common methods of adjusting car brakes

ECCESTRIC CAMS

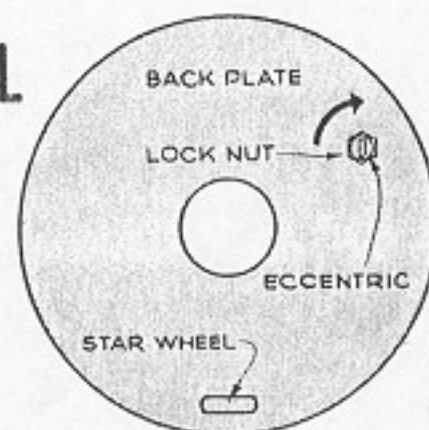


1 MOVE CAM OUT UNTIL WHEEL LOCKS;
BACK OFF SLIGHTLY TO FREE EACH
SHOE IN TURN

2 OPERATE BRAKES AND CHECK FOR DRAG



STAR WHEEL AND ECCESTRIC



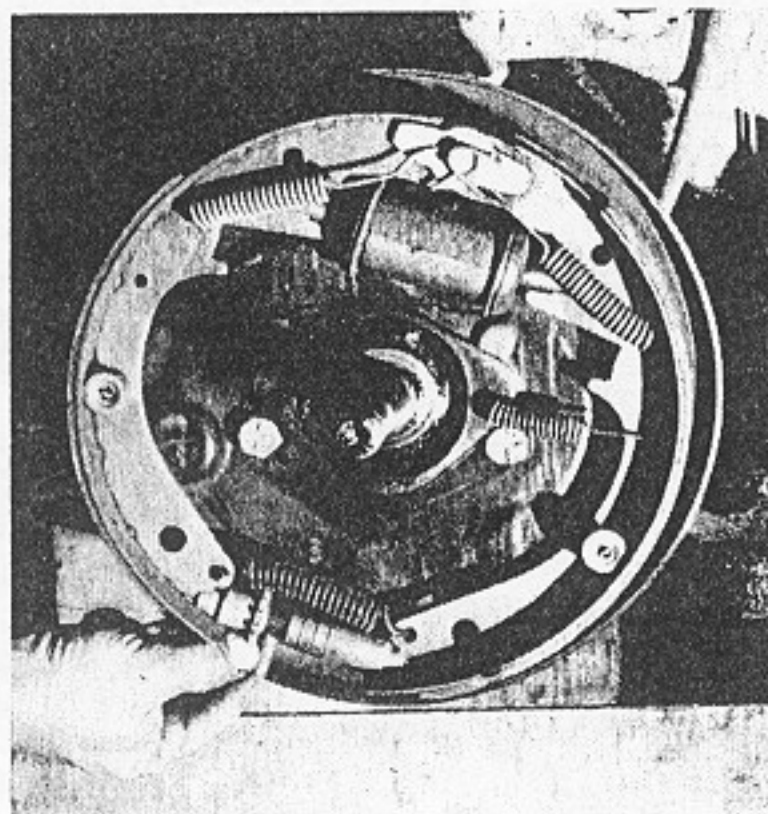
1 LOOSEN LOCK NUT

2 SET SHOE TO .010" CLEARANCE

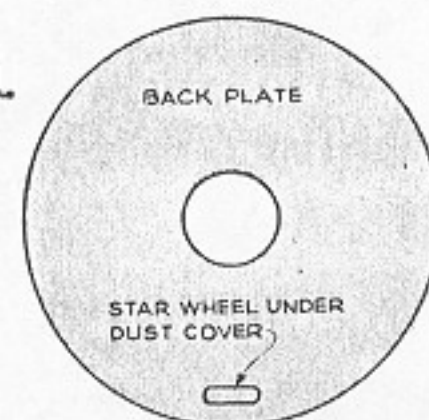
3 TIGHTEN LOCK NUT AND RECHECK
CLEARANCE

4 LOCK WHEEL WITH STAR-WHEEL
ADJUSTMENT AND BACK OFF TO FREE

5 OPERATE BRAKES AND CHECK FOR DRAG

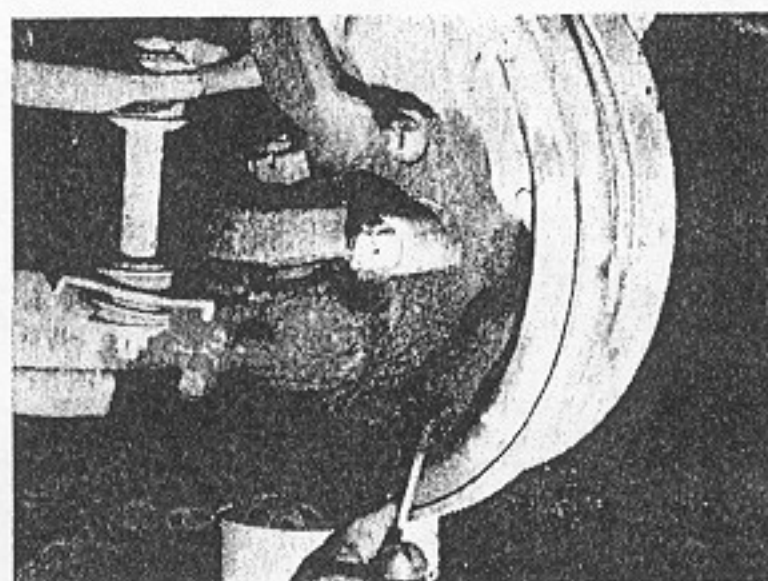


STAR WHEEL



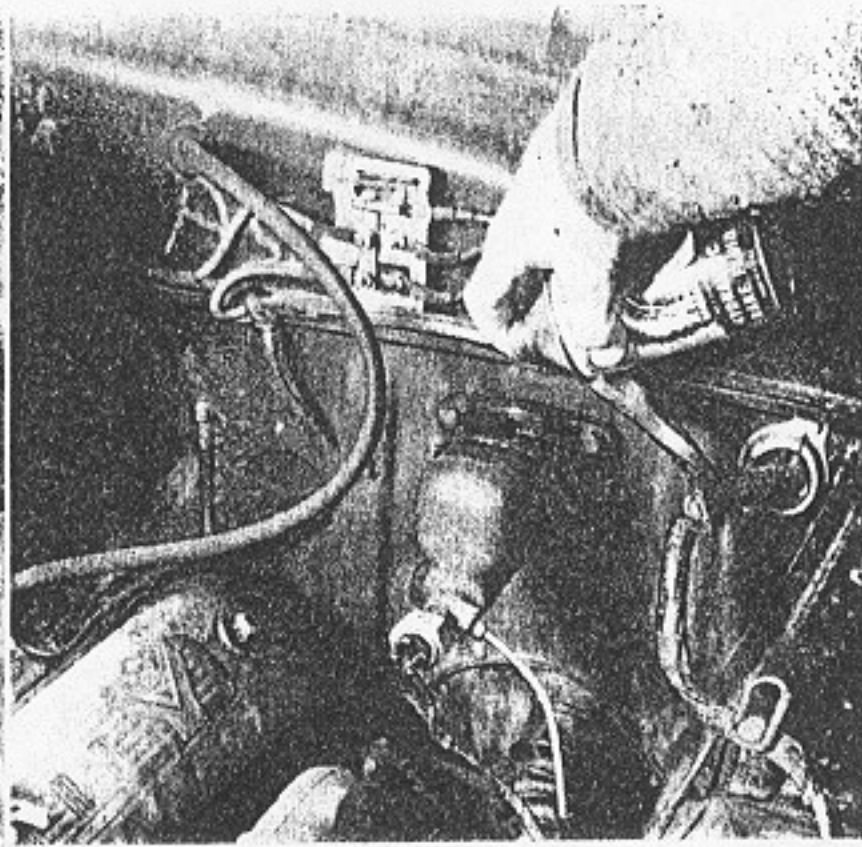
1 PRY NOTCHED WHEEL TO TURN IT AND
LOCK BRAKE; BACK OFF TO FREE WHEEL

2 OPERATE BRAKES AND CHECK FOR DRAG





HYDRAULIC-LINE INSPECTION might save your life. You'll never have a better chance than during a brake job. Go over the hose and fittings for signs of leakage, drying out, or rubbed spots. Check the metal lines for kinks.



ADDING A LITTLE FLUID to master cylinder, to compensate for greater amount now remaining in wheel cylinders, is the final step in a brake job. Before removing the cover, be sure to wipe away all dirt from the surrounding area.

you scrape away the mud and road tar.

Since each shoe has a cam, you must adjust first the front and then the rear shoe on each wheel. There is nothing difficult here except that corrosion sometimes sets these parts to an eyeball-popping tightness that demands a good wrench and real manpower to move.

A combination of star wheel for final adjustment with an eccentric for initial adjustment is the third system, also very common. The eccentric is an innocent-looking little flat-sided screw with a lock nut. It turns much easier than the previously mentioned cams, once the lock nut has been backed off about one turn. You'll probably find that a very minute adjustment will lock the wheel solid. So be careful when retightening the lock nut that the adjusting screw doesn't sneak up a turn on you.

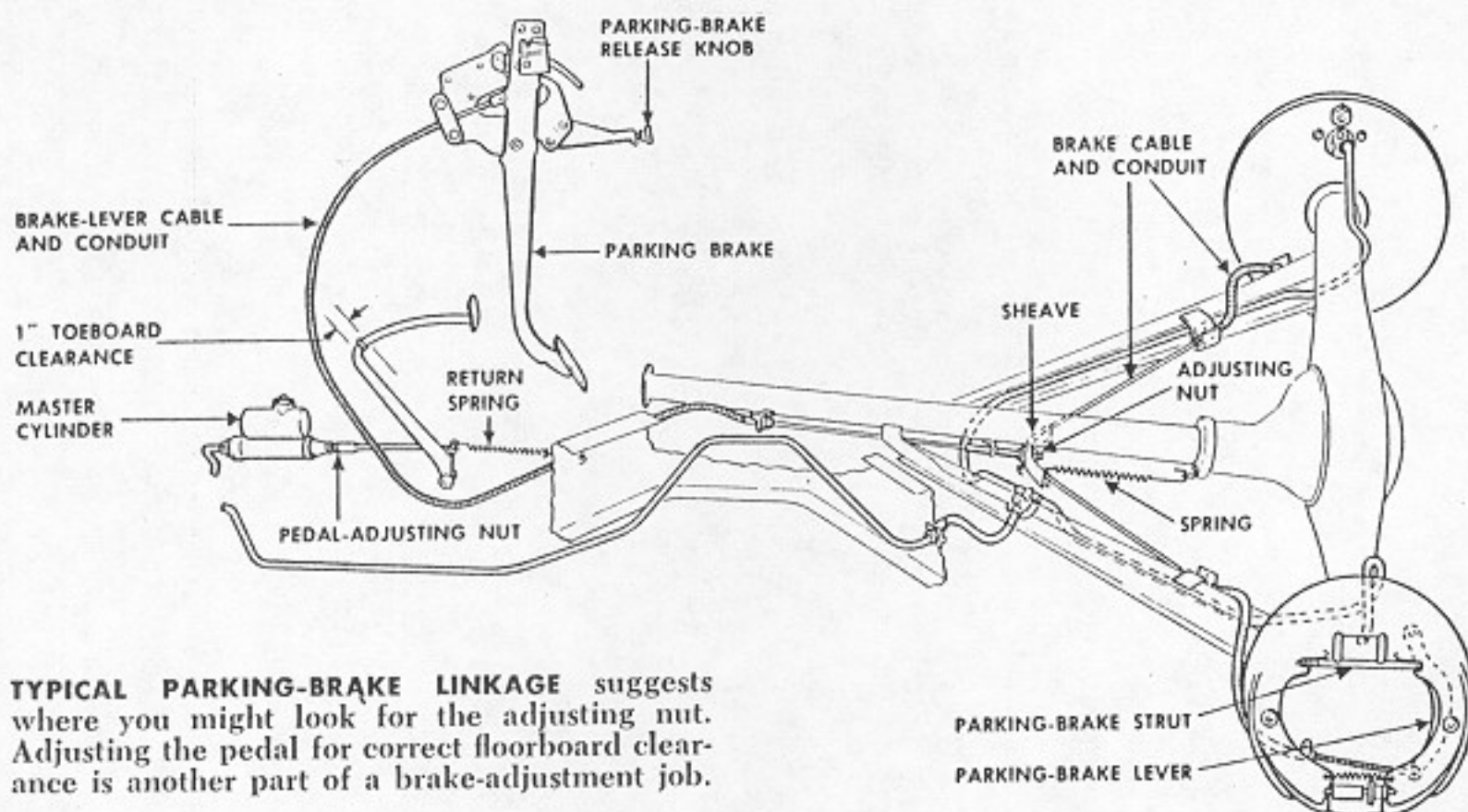
This type of brake often has a slot in the drum through which you can poke a feeler gauge, usually specified as .010" thick, to set the eccentric. This is the best method, but you probably will make out all right if you merely tighten the eccentric enough to lock the wheel and then back it off until the wheel is free. Follow this up similarly with the star wheel: Tighten to locked-wheel position, then back off slightly.

It's best to remove the wheels. If you go into a garage for a brake adjustment, the mechanic probably will do it quickly without removing the wheels. This is not necessarily wrong. It's certainly better than driving around with poor brakes. On the other hand a lot of dust accumulates in brake drums. To an inexperienced adjuster the noise of dust may sound as if the shoes are dragging. The result is that he backs off the adjustment *too far*.

Hence the writer recommends pulling at least the front wheels—if for no other reason than to check the condition of the lining and to study the construction of the brake so that you'll understand how the adjustment works.

Be careful to keep dust from falling into the wheel bearings. Repack the bearings with clean *wheel-bearing grease*. You may not care to pull the rear drums once you have the feel of adjusting on the fronts. As a matter of good practice, however, if the drums can be removed without resorting to heavy-duty pullers, cleaning is worthwhile.

When you replace a wheel, use care in tightening the bearing nut or you may wind up with shimmy and fast tire wear. The recommended method is to pull up on the nut until drag can be felt



TYPICAL PARKING-BRAKE LINKAGE suggests where you might look for the adjusting nut. Adjusting the pedal for correct floorboard clearance is another part of a brake-adjustment job.

when the wheel is turned. Then back off to the closest cotter pin. If the nut doesn't seem to have a slot in quite the right spot, cut a thin shim washer and put it between the nut and bearing outer washer.

The entire operation can be summarized as follows: Jack up the car and adjust either the star wheel, the eccentric and star wheel, or the front and rear cam on each wheel to lock the wheel. Then back off slightly for free running. Work the brakes and recheck for free running several times. When adjusting the rear brakes, be sure that the hand-brake cables aren't too tight and holding the brake in the on position, or that they are so loose as to be useless.

Check for an inch or so of free travel of the brake pedal on conventional brakes. (Power brakes use less free travel.) If you don't have at least an inch of free pedal travel on a conventional system, ease off on the connection between the pedal and master cylinder until you do. Failure to have this clearance may result in dragging brakes if the fluid in the system expands from heat and forces the master piston backward in the cylinder, and the pedal goes down before the lip of the piston cup clears the cylinder relief port.

Adjusting the hand brake. Before adjusting the rear brakes, it is a good idea to give a lusty tug on the cables leading to the hand-brake linkage. These are easily identified since in most cars they run from the rear-brake backing plates to some sort of pull-rod linkage under the drive shaft or transmission.

Tight cables could interfere with adjustment, so the instruction manuals all say to slack them off by loosening the adjustment nuts where the cables join the pull mechanism. Actually, the opposite is generally the case, with the cables sloppy enough to permit adjustment and stand a bit of tautening.

For a practical sequence, check the cables and loosen if needed; adjust the brake shoes and try the foot brakes; then snug up the cables so that they are just tight enough to get results when needed, but not so snug as to prevent complete release of the emergency system.

There are two ways to check for overtightening of the cables: One is to let some friendly driver flag you down and inform you that your rear brakes are smoking. A better way is to spin the drums by hand while someone works the hand brake to see if there is an inch or so of free movement before the drag of the wheels is felt. END

END

CAR SPRINGS

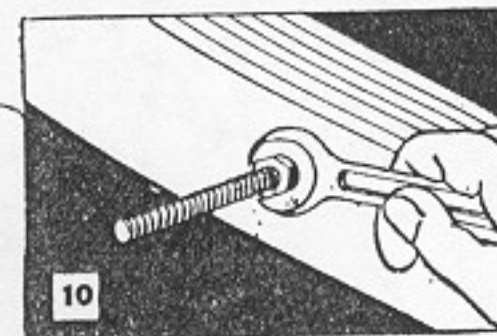
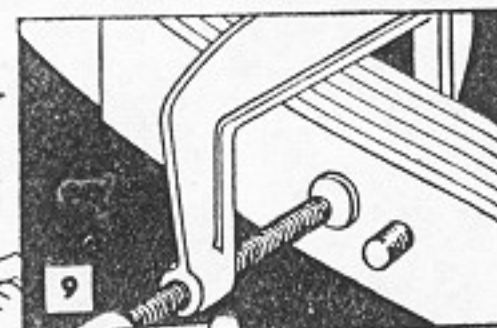
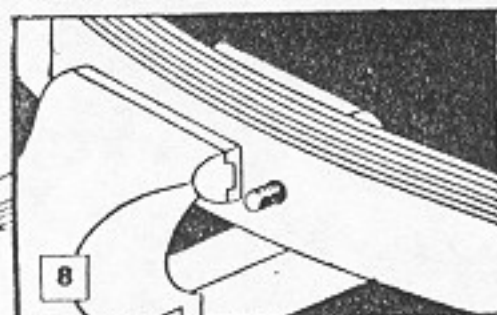
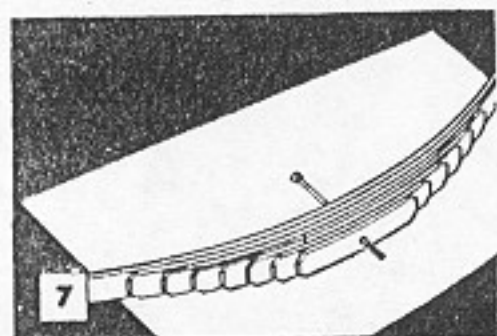
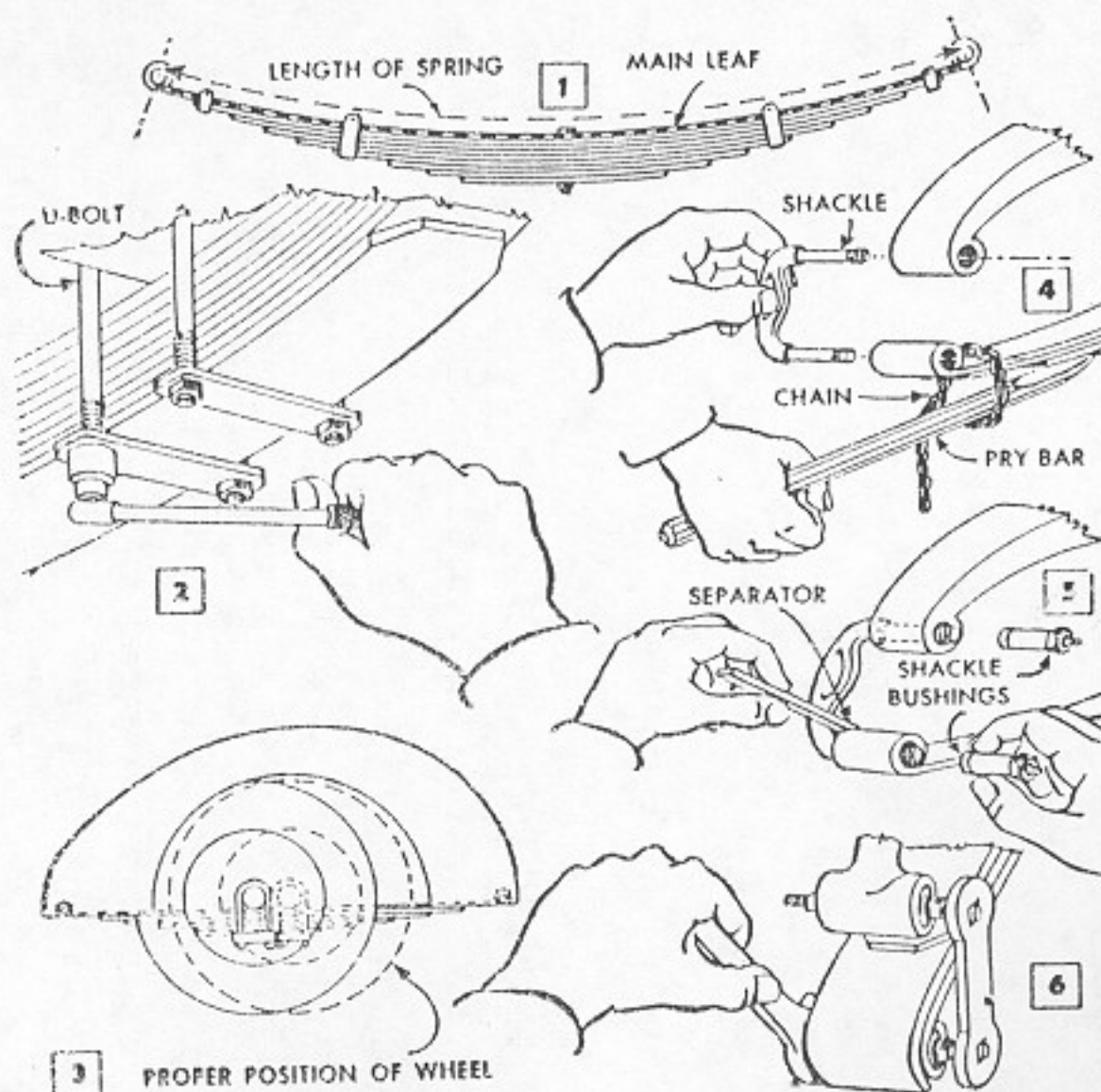
ALTHOUGH repairing or replacing a broken or damaged spring is a simple job, waiting for your turn to have it repaired may take several days. Rather than have your car or light truck out of service for this length of time, why not install the spring yourself? Figs. 2 to 6 inclusive detail the usual procedure in removing a spring. If the spring is to be replaced, or if it is necessary to replace the main leaf, it's important to know the exact length. Fig. 1 shows how to measure it correctly. Before loosening any of the parts or jacking up the car, block both the front and rear wheels securely. Use a roll-away jack if the work is done on a level floor. Assuming that a rear spring is to be removed, place the jack against the frame about 6 in. ahead of the spring. Raise the car until the spring assumes the normal "free" arch when tension due to weight of the car is removed. Wheels should not leave the floor. Block up under the frame at a point near the jack. Disconnect the shock absorber if it interferes. Then remove the U-bolts, Fig. 2, and the front and rear shackle pins to free the



eyes of the spring. On some late-model cars, such as Nash and Hudson, the emergency-brake cable is clipped onto the spring. In this case it will be necessary to cut the

clip bolt and replace it with a new one when the spring is installed.

Installing a spring after servicing or repairing it is just as easy as the removal if the correct procedure is followed. Figs. 7 to 10 inclusive detail the first steps. Arrange the spring leaves on a table according to size and length. If the center holes of the leaves are not equally distant from the ends, be sure before installing the center bolt that the long ends face the same way. Align the leaves with a straight pin or rod of the same diameter as the bolt, Fig. 7. Don't attempt to draw up the loose leaves with the center bolt; you are very likely to strip the threads. With the pin in place, tighten the spring in a heavy vise as in Fig. 8, or with C-clamps as in Fig. 9. Remove the pin and install the



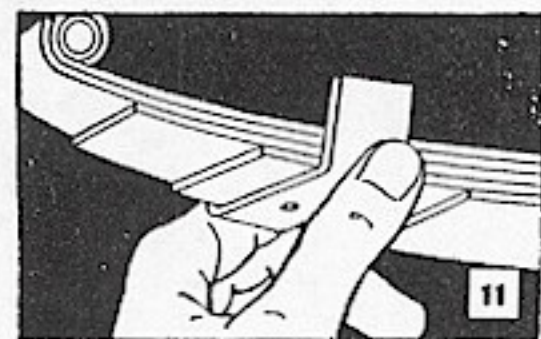
bolt $\frac{1}{2}$ in Fig. 10. On overslung springs, the head of the center bolt should be on the short-plate side of the spring, but on underslung springs the head of the bolt should bear on the main leaf. Any projection of a new bolt beyond the nut after tightening, Fig. 10, should be cut off. Align the center-bolt head as in Fig. 18. The spring clips may now be installed, Figs. 11 to 14 inclusive. Place the U portion of the clip in proper position, with the nib fitting into the rivet hole. Apply the saddle so that the ends of the lower plate extend through the upper openings. Hammer down both ends firmly. Remove the clamps and the job is done.

When placing the spring back in position, be sure that you have it "right end to" so the car or truck axle will be in the correct position, Fig. 3. If the center bolt is in the center of the spring, and the eyes or bushings are the same at both ends, then there's nothing to worry about. But one must watch for springs with different eyes or bushings which must be matched with the shackles, to get the right end forward. Also some springs are made with the center bolt off-center. Sometimes this off-center distance is so small you won't notice it unless you measure carefully. Ex-

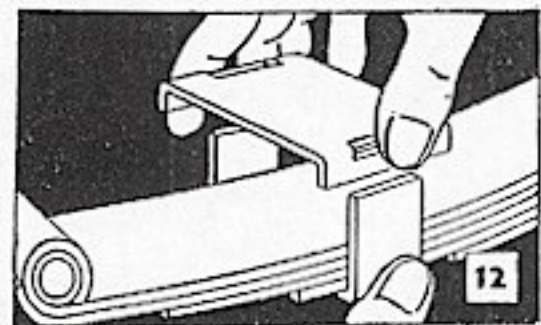
cept in a few instances, the short end of such a spring is always installed toward the front. Generally, the swinging shackle has ample freedom of movement so that assembly is easy. But for cars with U-shackles a separator must be used to keep the eye of the spring in position, Fig. 5. Also, it sometimes is necessary to place a jack under the spring near the center bolt and spread or flatten the spring sufficiently to bring the eye within reach of the shackle. Then with a pry bar and chain arranged as in Fig. 4 the spring can be brought into position so that the shackle will slip in place. If shackles are of the type shown in Fig. 6, place the shackle link on the stud of the perch bushing and line up with the spring-bushing stud. With a wrench turn the spring stud so that the opening in the link will fit over the squared section of the stud. Then turn on the nuts, tighten, and install cotter pins.

On Ford, Lincoln and Studebaker cars it is necessary to use a spring spreader made from a length of pipe and a threaded rod as in Fig. 16. When removing worn or defective perch bushings on Ford, Mercury and Lincoln cars use a bushing remover made from a cold chisel, Fig. 17. Regrind the edge as indicated. Install the rebound clips, Fig. 18. Tighten the U-bolt nuts in the order given in Fig. 19, drawing each nut a little at a time until tight.

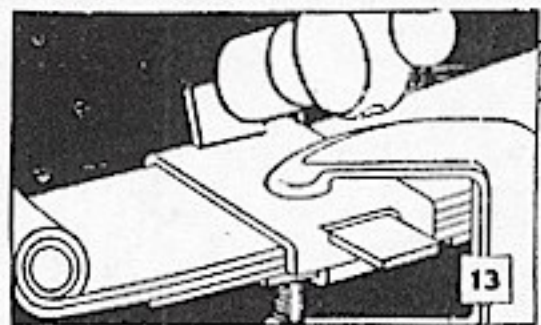
Courtesy Maremont Automotive Products, Inc.



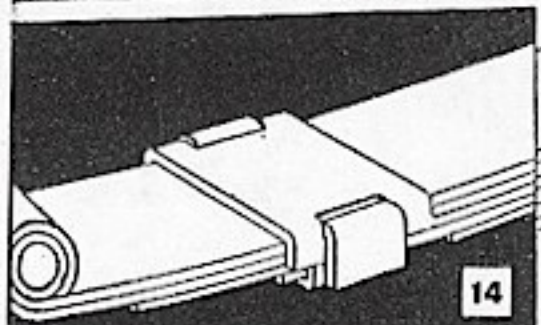
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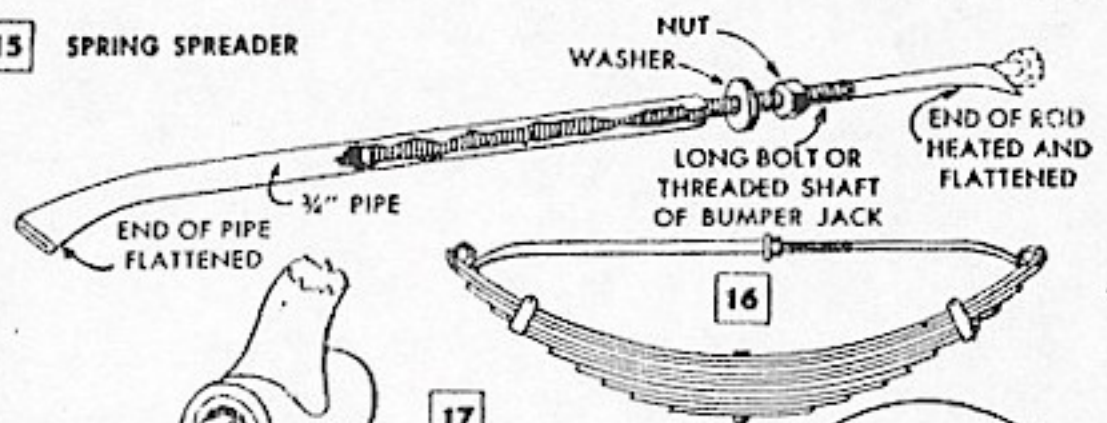


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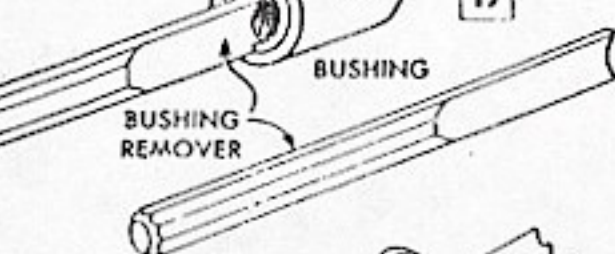


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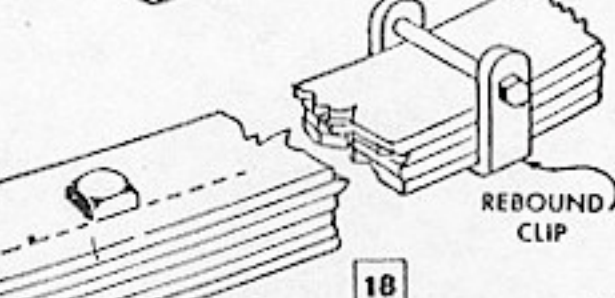
15 SPRING SPREADER



16



17



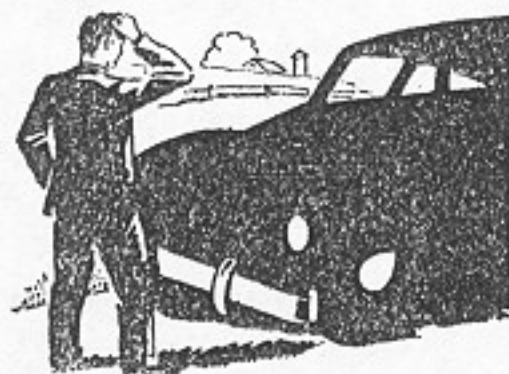
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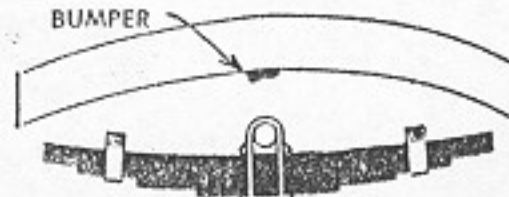
12-POINT SPRING INSPECTION

In most cases auto or truck springs do not break suddenly or unexpectedly. Rather they tend to deteriorate gradually by processes of metal fatigue. Usually a "tiring" spring will give you plenty of warning with such common symptoms as you see illustrated in detail below

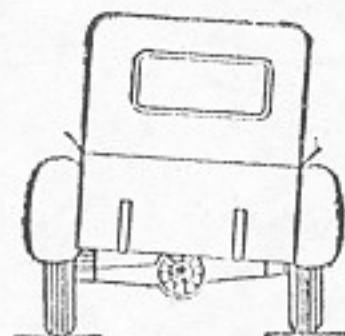


Courtesy Maremont Automotive Products, Inc.

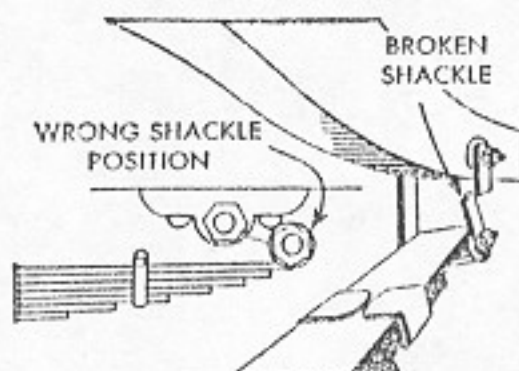
DAMAGED
RUBBER
BUMPER



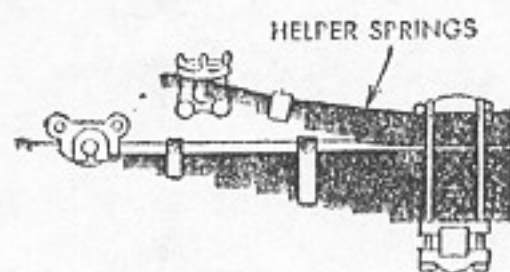
"Striking through" damages the rubber frame bumper. This not only indicates spring fatigue but sooner or later ruins the bumper entirely



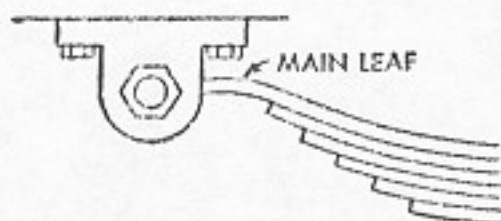
A low corner is almost sure to mean a broken spring or one that allows the body of the car to sag because of several cracked leaves



When the spring is weakened for any reason it pushes the shackle out of position. A broken shackle will eventually result from this



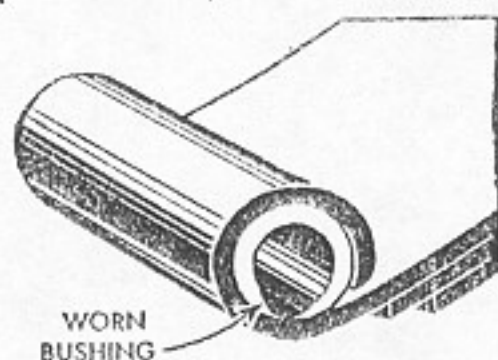
Should the helper springs touch the brackets when the truck is empty, the main springs should be replaced or repaired immediately



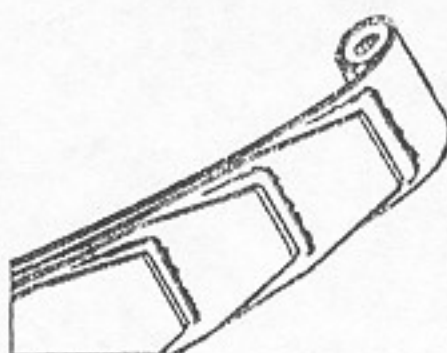
A frozen shackle will "seize" the spring eye and this will likely break the main leaf. Free the shackle, repair or replace the leaf



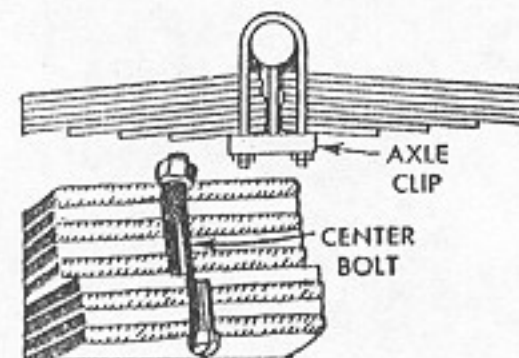
A "wrapped" spring is usually due to "rabbit" starts or repeated sudden, violent stops. Causes rapid axle wear due to misalignment



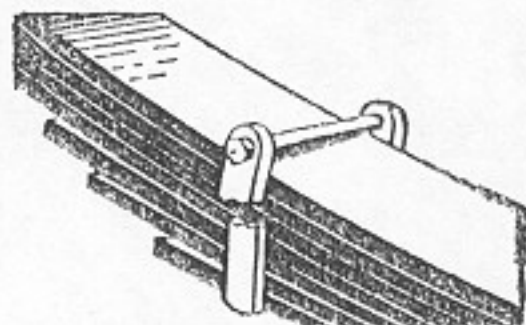
Worn bushings cause annoying knocks and rattles that are hard to locate unless you know symptoms. New bushings are the remedy



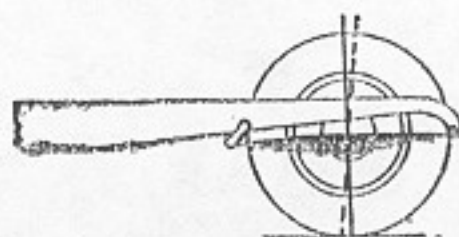
If the ends of the spring leaves cut in due to heavy loading, the spring will be weakened because of reduced thickness of the metal



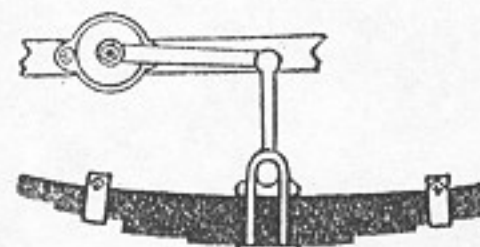
Sheared center bolts allow the spring leaves to shift. This quite often loosens the axle clip and causes breakage of entire spring



Broken rebound clips also permit the leaves to shift. This often has the effect of shifting the loading, causing springs to wrap or break



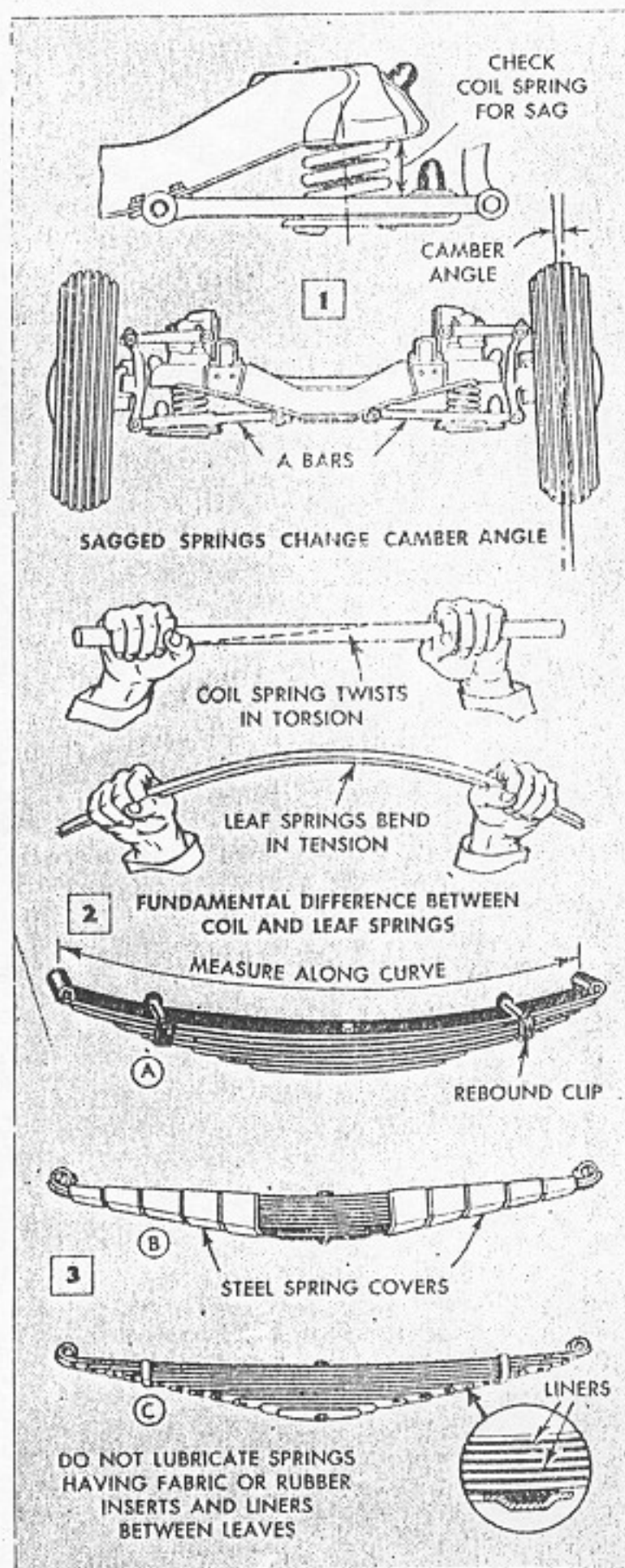
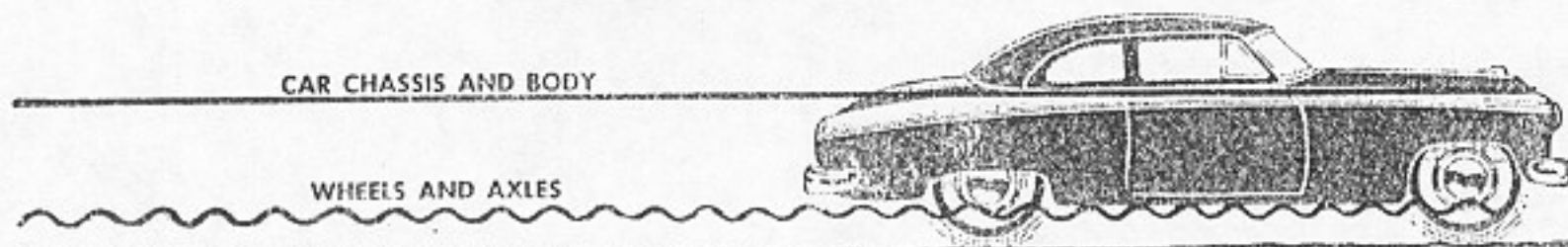
A sagged or broken front spring amounts to much the same thing as a shift in wheel alignment. It results in excessive wear on the tires



Defective shock absorbers can cause plenty of spring troubles, too. Keep them in good working order by periodic service and inspection

Keep Your Car Riding Like New

Straight-line steering and smooth riding qualities built into your car are retained by regular servicing of springs

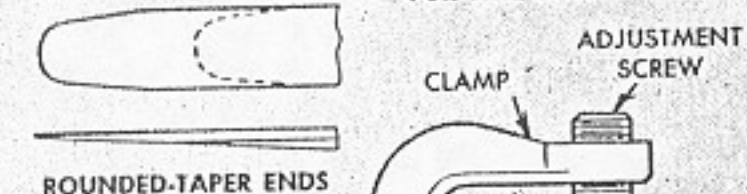
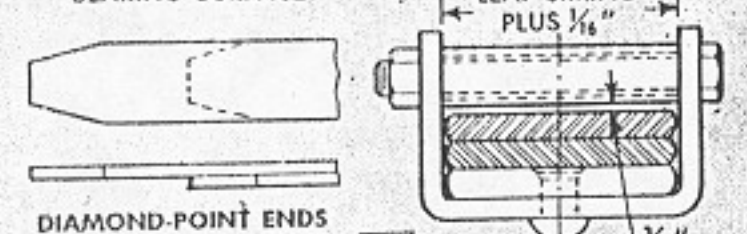
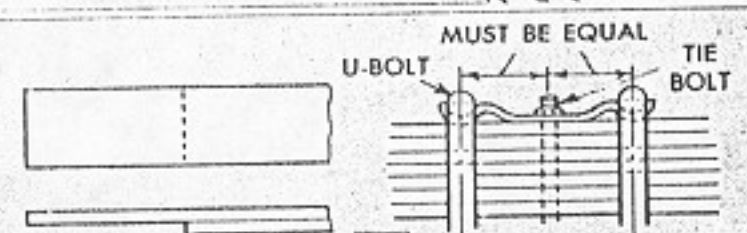
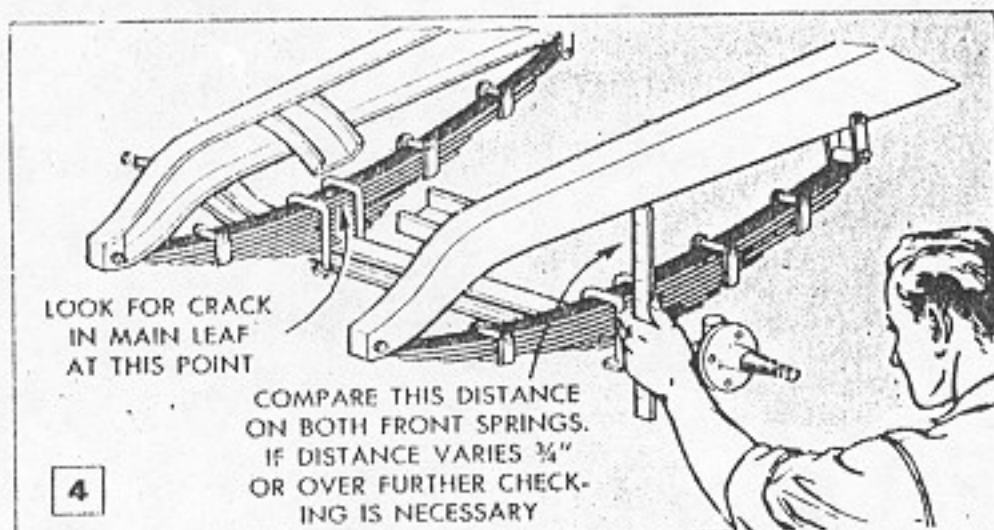


WHEN YOU hit a hole in the pavement or a bump in a side road the shock absorbers snub out rebound of the car axle but the springs take the real punishment by preventing the shock from reaching the car frame and body. Even when you're cruising on a smooth highway, the springs soften the ride by constantly flexing to equalize irregularities in the road surface. Lack of lubrication can cause rapid wear in leaf springs, and rust and metal fatigue combine to cause a slow loss of "life" in a coil-spring suspension of the type shown in Fig. 1. Under normal load conditions, spring suspensions of this type are designed to operate with the A-bars, or control arms, in approximately a level position. After years of service the springs may weaken and, in effect, shorten slightly under the body load which, of course, remains the same. This changes the normal position of the control arms and, in some cases, may even change the front-wheel camber as in the lower detail in Fig. 1. This condition can cause a serious loss in steering response and it also results in rapid wear on the tires. Often the defect can be corrected by shimming the springs with spacing washers which fit into the retaining cups at the top and bottom ends. However, if body sag is excessive, or if one spring is lower than the other, then both springs should be replaced. On some older cars it will be necessary to check steering and possibly to realign the front wheels after shimming or installing springs. On certain newer cars, coil springs may be shimmed or replaced without changing the wheel alignment. Coil springs are simply torsion bars, upper detail in Fig. 2, and any surface flaws caused by rust will weaken them. To protect coil springs against rust, keep them well painted or coated with any of the rust preventives which are available.

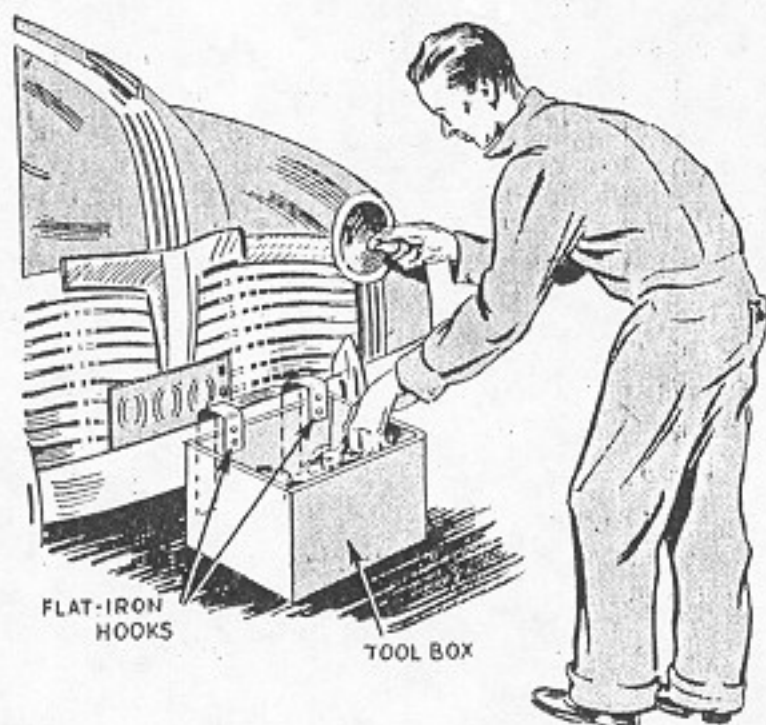
Leaf springs and shackles on nearly all older-model cars and trucks require lubricating at regular intervals. The method of lubricating depends on the type of spring and the provisions made by the

manufacturer for applying lubricant. All leaf springs bend under tension as in the lower detail in Fig. 2 and on nearly all cars more than 10 years old the springs are of the type shown at A in Fig. 3, the ends of the spring leaves being cut square or diamond pointed as in Fig. 7. Some, however, were made with round, tapered ends on all the leaves except the top leaf, Fig. 7. On later-model cars, and on some light trucks, the leaf springs either are fitted with steel covers as at B in Fig. 3, or are of the nonlubricated type detailed at C. On the older-type springs, Fig. 3.A, it may be necessary to loosen the rebound clips and pry the leaves apart in order to apply lubricant between the leaves. Whenever such springs are lubricated always make the checks detailed in Figs. 4, 5 and 6. If measurement from the top of the spring to the lower side of the frame varies more than $\frac{3}{4}$ in., check the low spring carefully for a broken leaf or excessively worn shackle bolts. Renew faulty parts, as otherwise lubrication of the spring may increase leaf deflection and result in breakage of adjacent leaves. If possible, use the lubricant specified by the manufacturer of the car. Otherwise use chassis grease to which a small quantity of powdered graphite has been added, or use penetrating oil.

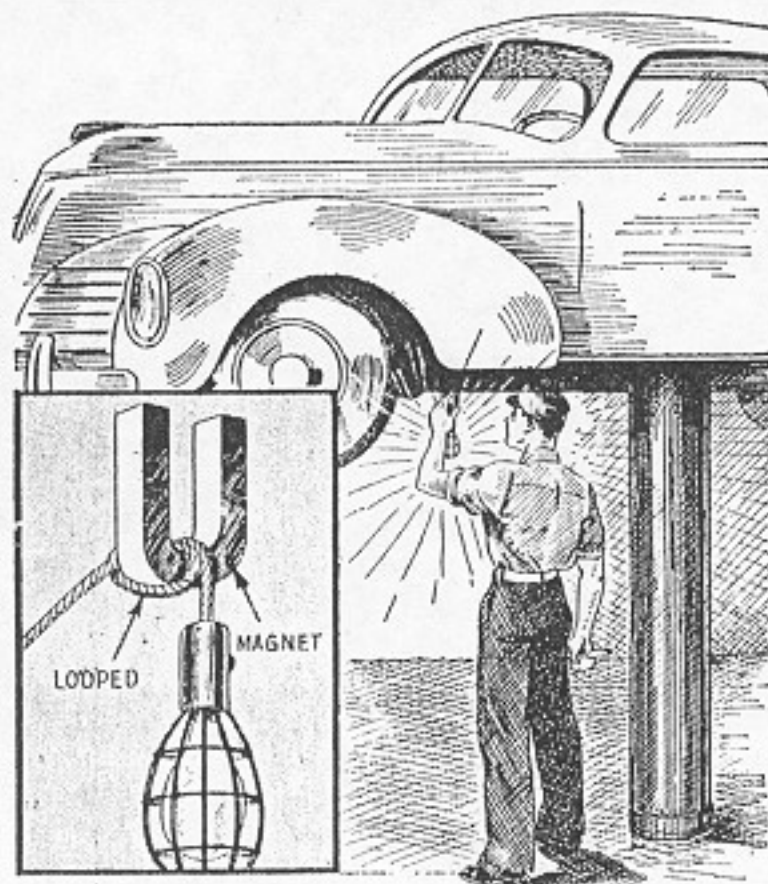
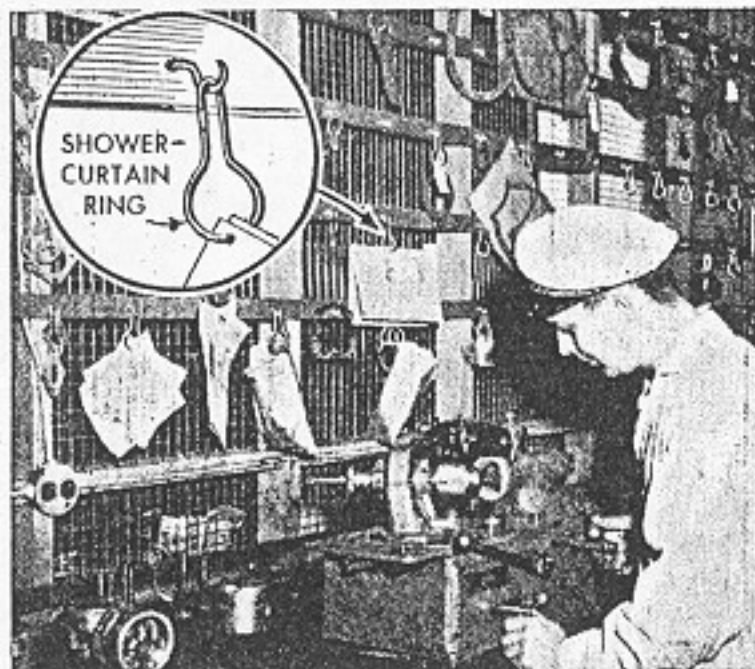
Lubrication of covered springs is easily done, without removing the metal cover, by the use of the special spring-lubricating fitting detailed in Fig. 8. On some of the late-model cars the need for lubrication of the leaf springs has been eliminated by the use of waxed fabric liners between the adjacent leaves, detail C in Fig. 3. On others, rubber "buttons" are placed under the tips of the spring leaves. The only service required on springs of this type is replacement of worn liners or buttons. This is done by jacking up the car body to take the weight off the springs. Then the leaves are pried apart with a screwdriver or a special spring spreading tool, and the worn liners or buttons are removed from the depressions in the leaf tips and replaced. On some liners, only the worn ends are renewed. This is done by wedging the leaves apart and cutting off the worn portion of the liner with a hacksaw blade. Replace with new end sections of liner fabric. When the rebound clips are removed for any reason, be especially careful when replacing them to see that they fit with the correct clearance, Figs. 5, 6 and 9. This clearance is important as it allows the main leaf to twist when the car or truck is driven diagonally across a low culvert or onto a ramp.



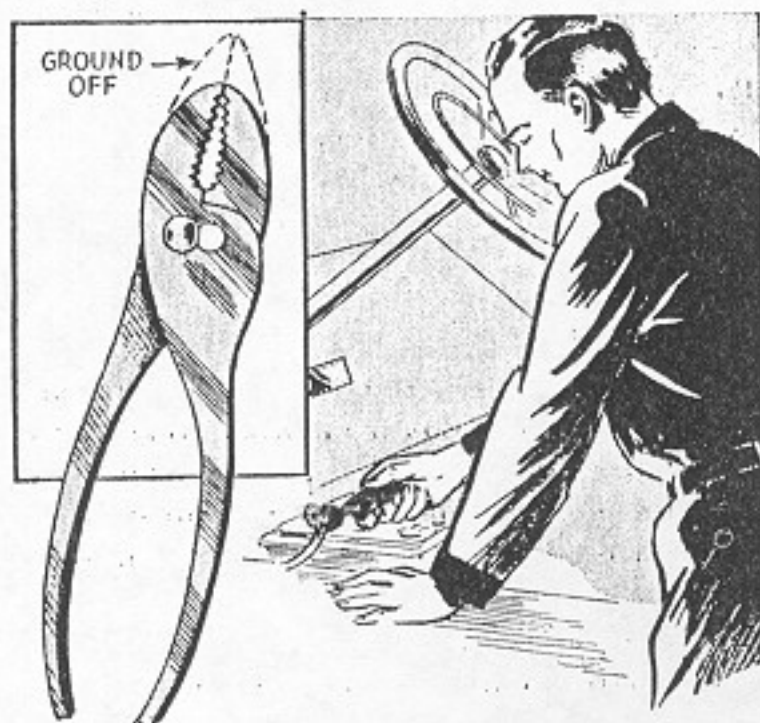
Auto Mechanics Find These Four Kinks Handy



One mechanic who had considerable headlight repair work to do found the box shown above a time and labor saver, especially when working on a car outside the garage. It contains everything necessary, thus making extra trips inside the garage for parts and tools unnecessary. It hooks over the car bumper where it is conveniently within reach. It is a good idea to partition the box to keep the various sizes of bulbs separated, and also to protect them against breakage by coming in contact with the tools in the box. As shown in the upper right-hand photo, another mechanic used shower-curtain rings on the walls of a maintenance shop to hold a variety of gaskets, which often were damaged or lost when kept on shelves or in drawers. Also, it was found that the rings were ideal for the safe keeping of bills, receipts, memoranda, etc. The lower right-hand drawing shows how a mechanic solved the problem of hanging his extension light when lubricating a car on a rack. By looping the light



cord over a large horseshoe magnet, the latter could be stuck any place on the car chassis to hold the light in the desired position. With a slight alteration, a pair of inexpensive utility pliers can be made to serve the purpose of a pair of expensive battery pliers shown in the lower detail. On most pliers of this type, grinding off the ends of the jaws as indicated by the dotted lines in the detail is sufficient.



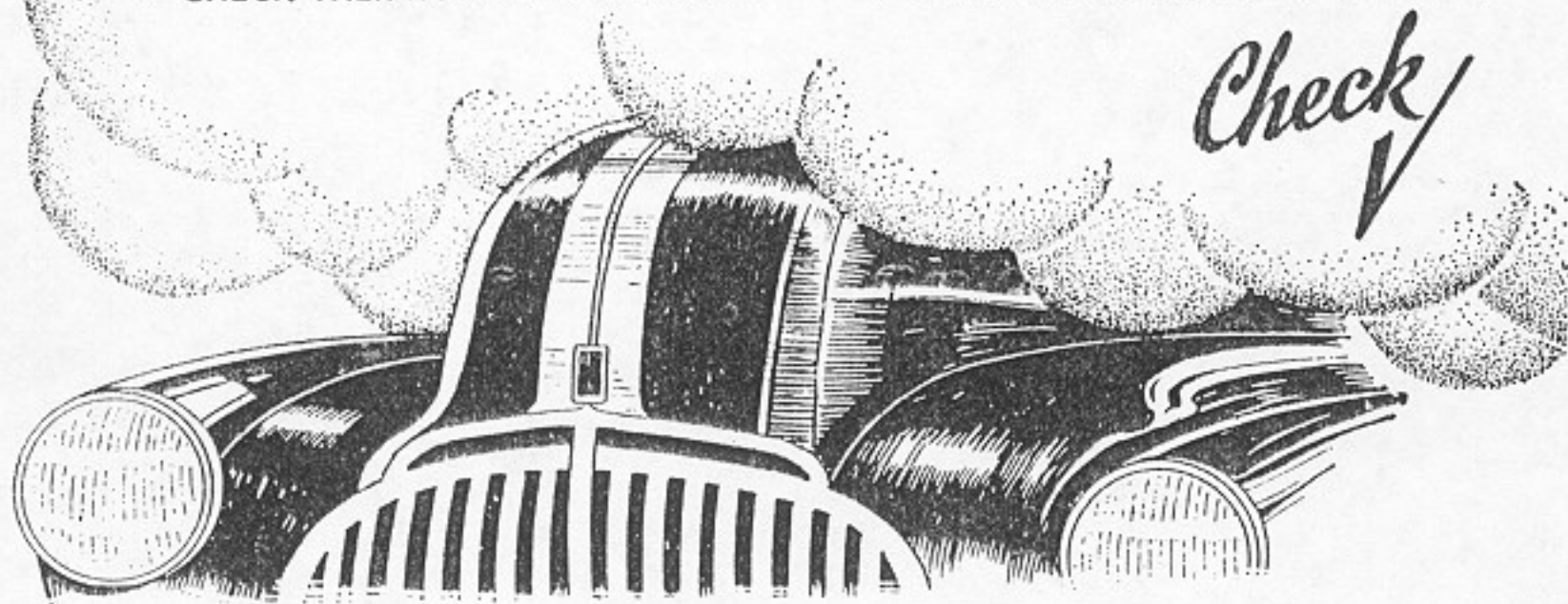
Waterproofing Car Stickers

When moisture repeatedly collects on windshields during winter months, it often loosens the adhesive on windshield stickers, such as federal tax stamps, city licenses, etc., causing them to fall off or chip at the edges. To prevent this, coat the back of the stickers with clear fingernail polish, which provides a waterproof backing.

CAR COOLING SYSTEM

GET RID OF WINTER'S RUST AND SCALE

- ✓ CHEMICAL FLUSH THE RADIATOR
- ✓ REVERSE FLUSH RADIATOR CORE
- ✓ REVERSE FLUSH ENGINE JACKET
- ✓ CHECK THERMOSTAT OPERATION
- ✓ EXAMINE WATER HOSE FOR DEFECTS
- ✓ INSPECT THE FAN BELT FOR PLAY
- ✓ BLOW OUT THE RADIATOR CORE
- ✓ LOOK FOR WATER-PUMP LEAKAGE



SPRING means cooling system time—time to “clean house” on rust and scale and to take this eight-point precaution against **overheating**—the costly penalty of engine neglect. It’s corrosion—rust, lime and grease left by hard winter driving—that retards heat dissipation and becomes the unsuspected cause of scored pistons, bearings and cylinder walls, burned valves and warped and cracked engine blocks. So play safe and guard the motor against these costly repairs by cleaning the cooling system regularly.

Chemical flushing: Draining the radiator of antifreeze and then simply flushing with water is not enough. A good cleaner is needed first to loosen the rust and scale. Such deposits act as an insulator and, if allowed to build up, may in time clog the fine water passages of the radiator. There are a number of efficient cleaning compounds on the market. Alkali-type cleaners, such as washing soda, are not entirely effective. They cut grease and sludge but have no solvent action on hard rust. Be cautious and select one that does not contain strong

acids or caustics which might be harmful to the radiator core, and be especially careful if your motor is fitted with aluminum cylinder heads. Some chemicals used in cleaning preparations to loosen scale will also attack aluminum and damage the heads severely in a short time. After the cooling system has been drained, close both drain cocks and add the cleaner as in Fig. 1. Then refill and clean according to the directions.

Reverse-flushing core: The loosened particles are removed from the radiator most effectively by reverse flushing, that is, flushing in the direction opposite to that of the normal flow of water through the cooling system. This is done by first replacing the radiator cap, opening both drain cocks and disconnecting the lower and upper hoses. As shown in Fig. 5, the flushing is done from below and a drain hose is attached to the top. A satisfactory job of flushing can be done with a garden hose as shown in Fig. 2, although a more thorough cleaning is assured with a flushing gun which combines air pressure with water to

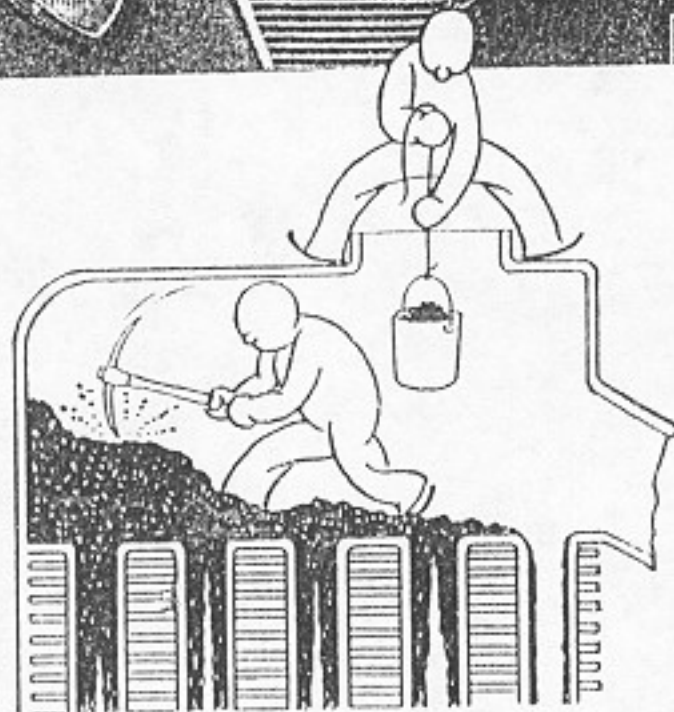
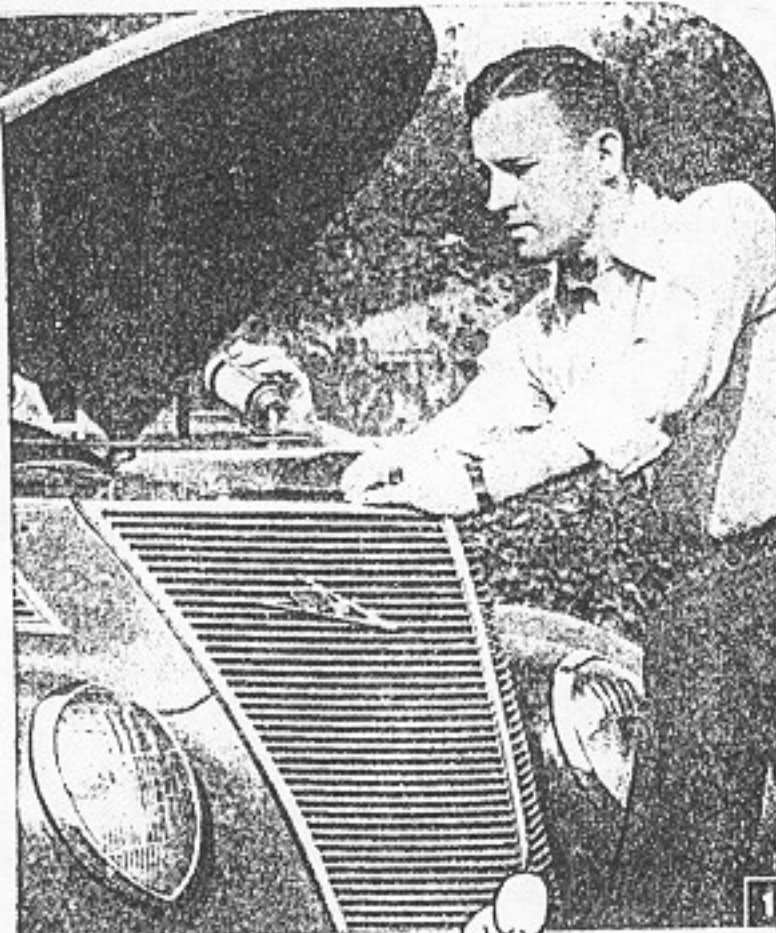


Don't be a Mr. Put-it-off. Make this eight-point inspection now and be ready for hot months ahead with a "cool" cooling system

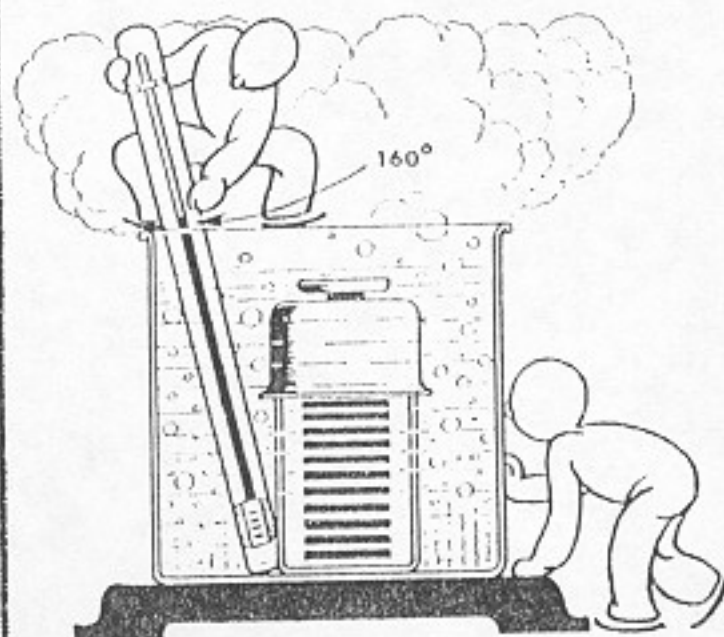
increase the scouring action and send the water through the system in forceful spurts. If such a gun is not available, a garageman will do the flushing job for you. However, be sure that you remove the thermostat beforehand, as cold water will cause it to close and build up harmful pressure. Flush until the water runs clear.

Reverse-flushing jacket: The same thing is done now to the water jacket, Fig. 3, which flushes the particles out through the water pump in the manner shown in Fig. 5. Attach a drain hose to the water-pump inlet, insert the gun at the top and flush as before. Some cars require removal of the water pump before pressure flushing to avoid unseating the pump sealing washer and forcing water into the pump bearings. If the car has a water heater, it should be flushed out too, as rust particles will form in the heater core as they do in the radiator.

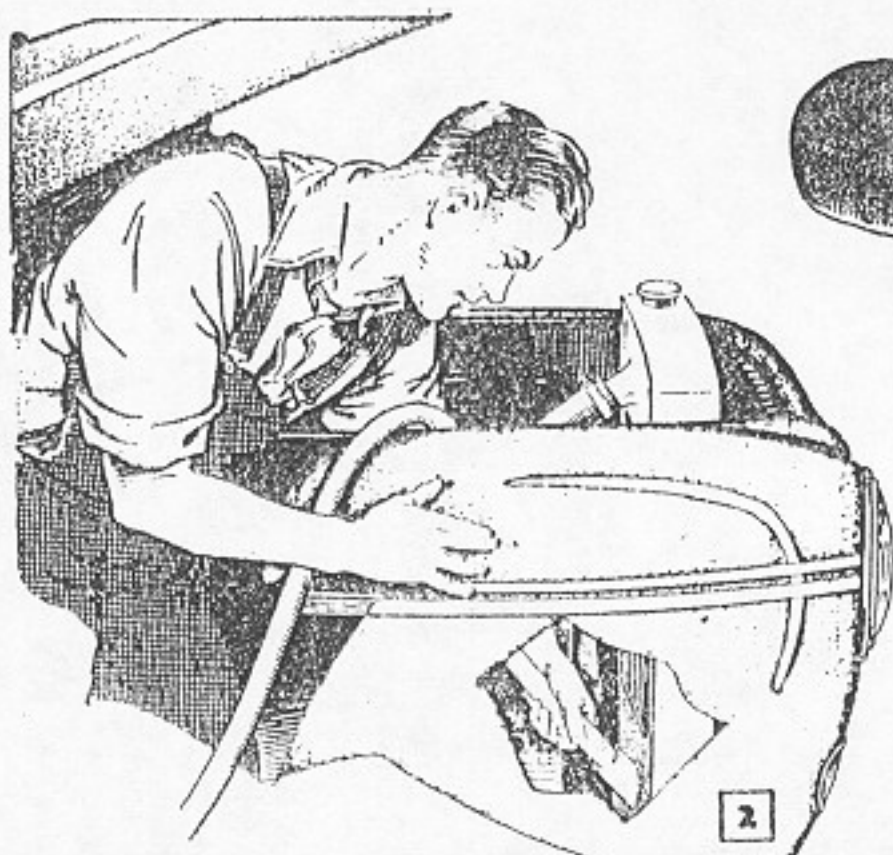
Thermostat test: After flushing, make sure that the thermostat is functioning properly. Normally, this can be checked by the gauge, but an accurate test can be performed by suspending the thermostat in water heated somewhat above the rated temperature, which is usually



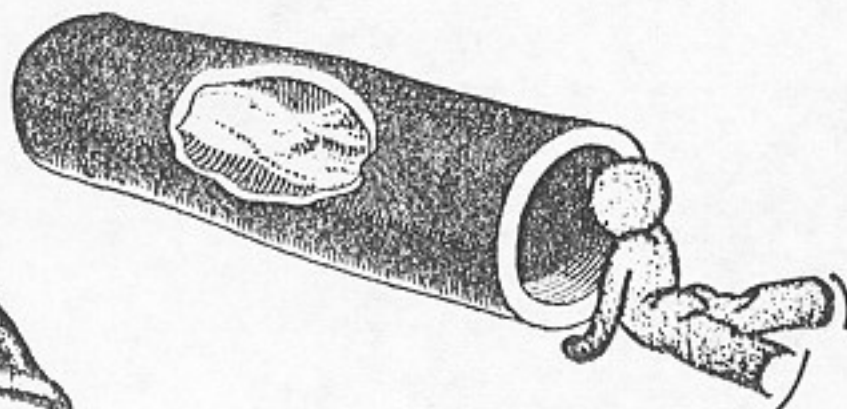
Here's how rust, boiled out of water jacket, can build up to obstruct the radiator tubes



Test thermostat's working order. Gummy one that fails to open causes overheating



2



Radiator hose wears out too. Gradual deterioration loosens lining which may retard the flow of water, and particles of rotted rubber can be carried into radiator water passages

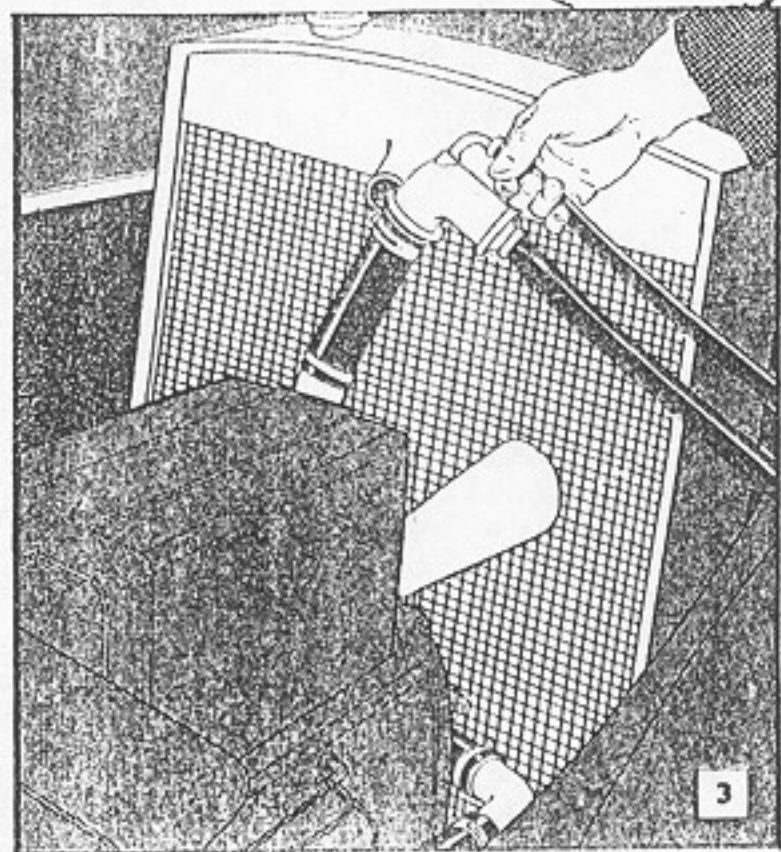
marked on the thermostat. If you find that the valve fails to open within 10 or 15 degrees of the rated temperature, it should be cleaned, if gummy, or replaced, as a faulty thermostat will cause the engine to overheat.

Water-hose checkup: Don't replace the radiator hoses without first examining them carefully, especially on the inside, for deterioration. If there are signs of rotting, replace them, as loose particles of rubber may clog the water passages of the radiator. Also, too soft tubing may collapse from suction. When replacing either the old or new hose, use gasket shellac on the metal parts over which the hose slips to assure an airtight seal at this point, and draw up the hose clamps tightly. Now, refill the radiator, preferably with soft or rain water. Lime in hard water causes scale to form in water passages much the same as it does in a teakettle. Bring the water level to about $\frac{1}{2}$ in. above the top of the tubes in the radiator. Avoid "filling" either summer or winter. Be sure to add a can of rust inhibitor, too. With a good active inhibitor in the water, rust can be kept to a minimum.

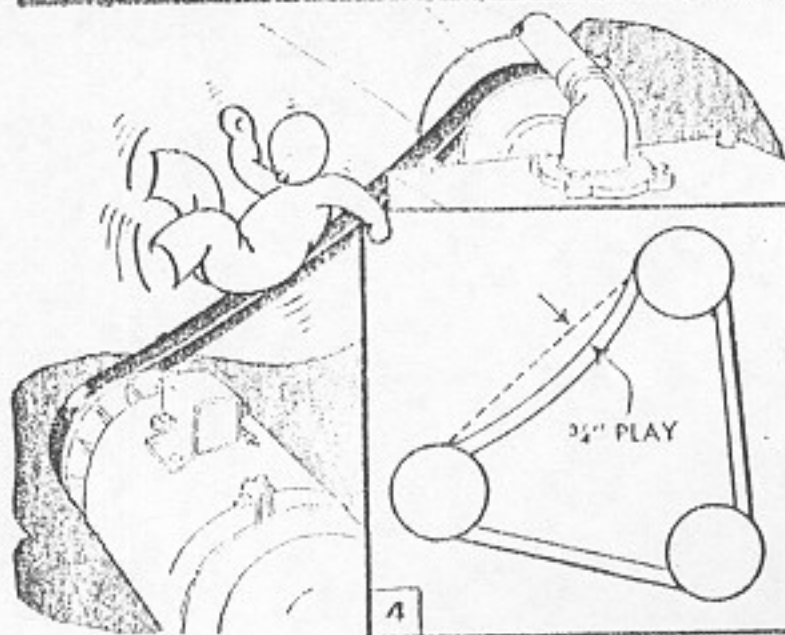
Fan-belt play: A loose fan belt is another source of overheating. If it slips, the fan speed is reduced. If it is too tight, there is excessive wear on the bearings. Adjust the fan pulley so that the belt can be depressed only about $\frac{3}{4}$ in. as in Fig. 4, and wipe off any grease that would cause the belt to slip.

Blowing out radiator: With dirt, insects and other foreign deposits clogging the air passages in the radiator core, heat dissipation is greatly reduced. Force out such deposits by directing a strong stream of water from a garden hose through the core from the rear. A bug screen is a good investment to keep these passages open.

Water-pump leakage: The water pump can be guilty of rust formation, too, by allowing air to enter the cooling system through a leaking packing gland. Oxygen in the air mixing with the cooling water in-

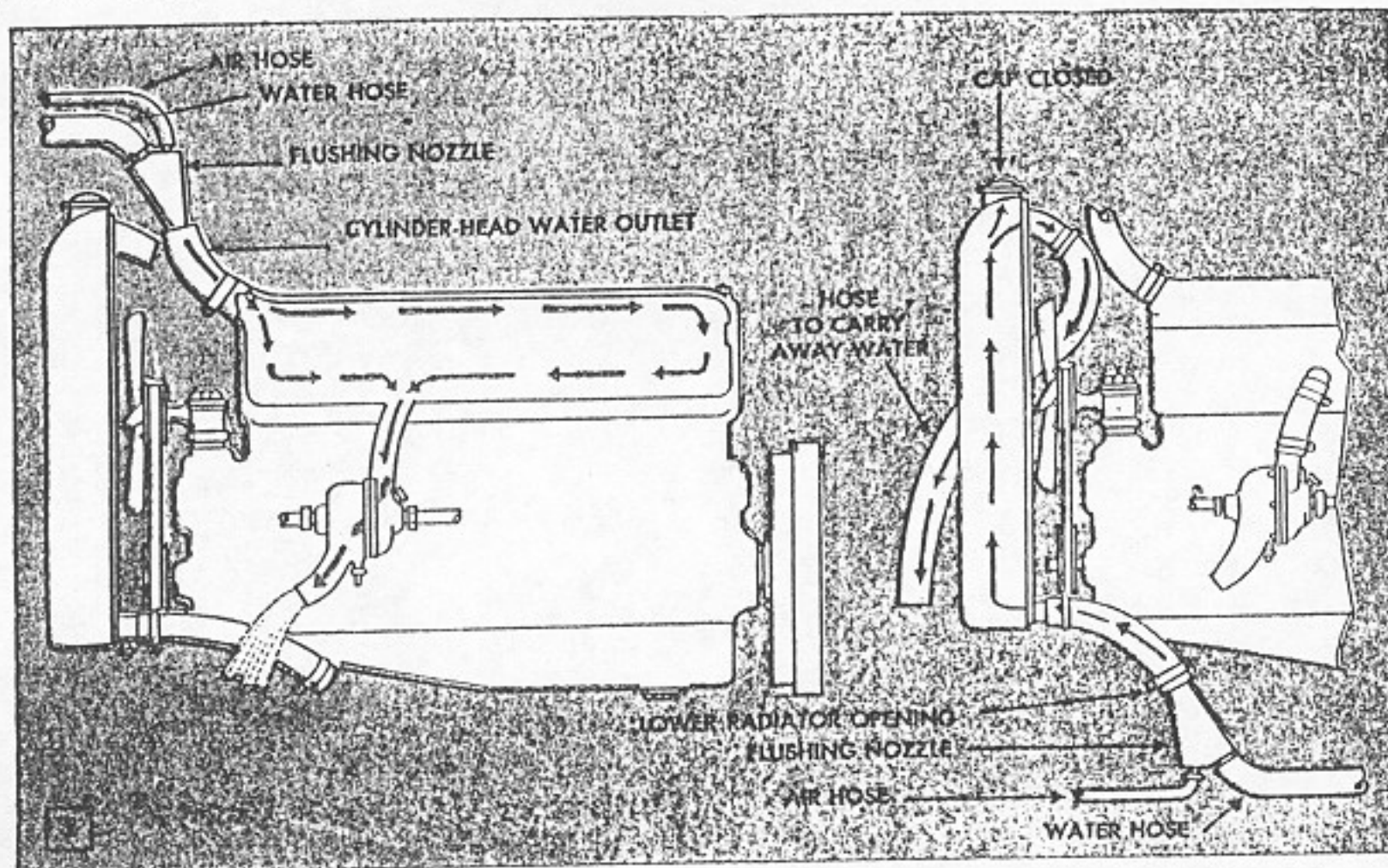


3

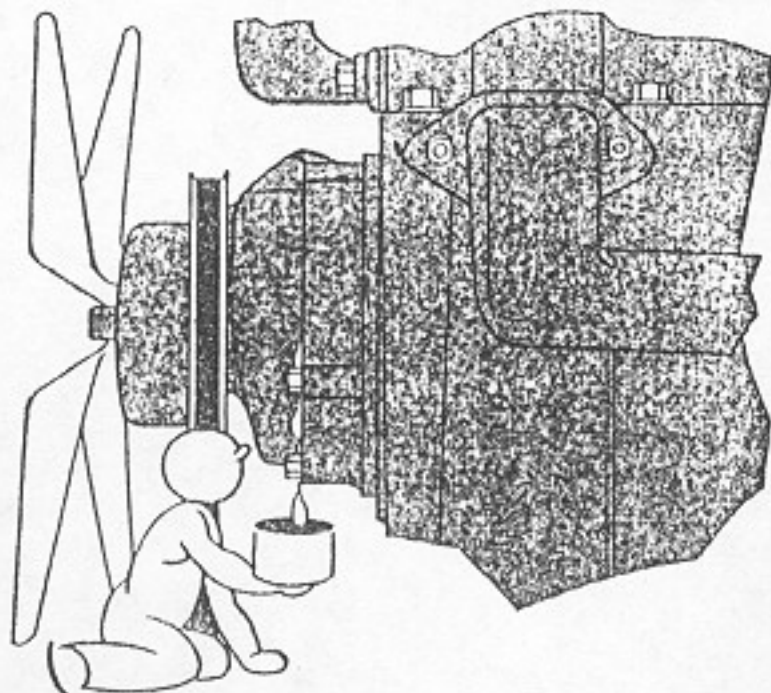
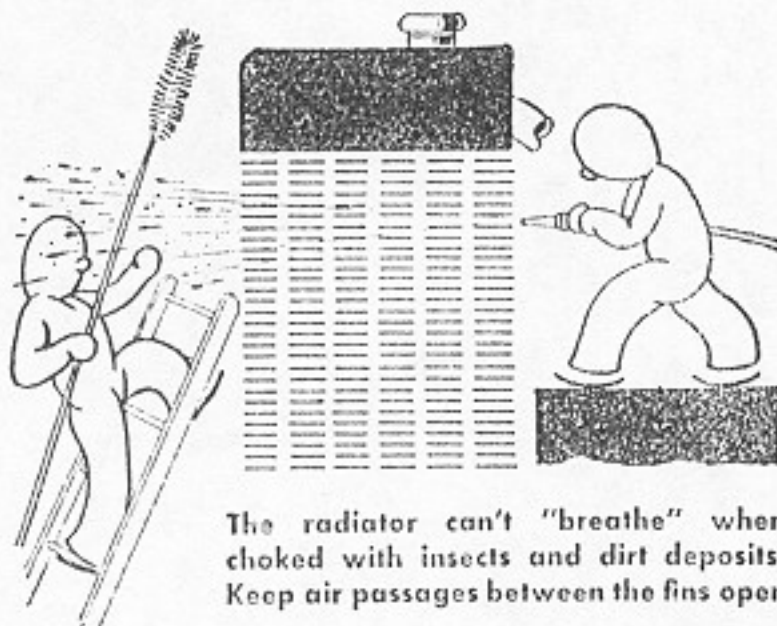


4

Cooling system suffers when fan belt is too loose. Both fan and water pump do their best when belt has $\frac{3}{4}$ -in. play. Tight belt wears bearings prematurely



creases rusting of the metal parts. Also, besides losing water along the pump shaft, air sucked in at this point causes a turbulent bubbling action of the water which results in loss through the overflow pipe and consequent overheating. Check for leakage while the engine is running, and repack the gland if necessary. Don't overlook grease and dirt on the engine. Even a thin accumulation acts as insulation and reduces heat radiation. Use a good grease remover, but avoid inflammable solutions and do the job outdoors. Don't start the engine before it has dried thoroughly. A loose cylinder head or a damaged gasket will allow gases, which contain strong corrosive acids, to enter the cooling system and speed the formation of rust. A telltale indication that leaks have developed is the presence of a rusty stain along the seam. Tightening the cylinder-head bolts sometimes will stop such a leak. However, if the gasket is actually broken, it should be replaced. In taking up on the bolts, care should be used to avoid cracking the head by tightening it unevenly. Check the front and rear of the engine water jacket and cylinder-head joint, and also the underside of the bottom tank of the radiator. Internal leaks may not be serious enough to cause loss of liquid into the cylinder or crankcase, but they may allow loss of gas from the combustion chamber into the water jacket. While this is not too serious, it's the gas bubbles in the water jacket that displace liquid and consequently raise the water level above the overflow.



Watch for possible leaks at the water-pump packing gland. Air sucked in at this point causes water to foam excessively, resulting in loss through overflow

Servicing Your **COOLING SYSTEM** *before Winter*

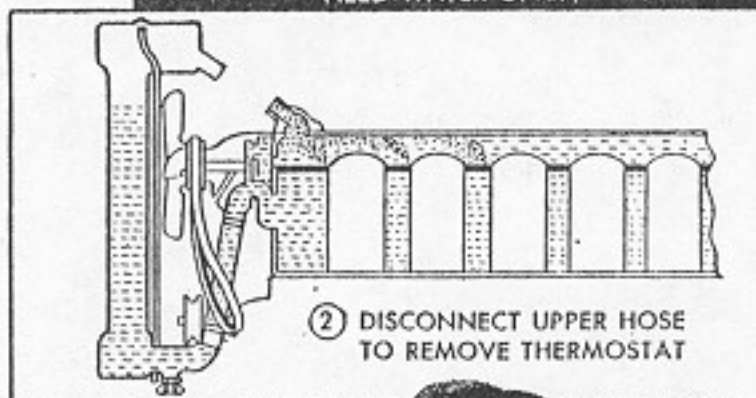
POOR gasoline mileage, burned bearings and valves, and scored pistons are some of the troubles that can be caused by a faulty cooling system. As all oils thin out under heat, a car motor that runs too hot has to operate on lubricants that lack film thickness essential for complete protection. On the other hand, a motor that runs cold is likely to be damaged because of excessive oil dilution. Besides this, a cooling system that allows the motor to overheat must be filled often, Fig. 1, which is both wasteful and costly when anti-freeze solutions are used.

Often, the cause of an inefficient cooling system lies in the thermostat. This should be closed when the motor is cold, but fully open when the coolant reaches a temperature somewhere between 160 and 180 degrees Fahr. It is easy to test the thermostat, which is located either in the upper hose or in the cylinder head close to where the hose attaches. In either case, the hose must be removed, Fig. 2, to get at the thermostat, which then can be removed and tested in a pan of heated water as in Fig. 3, using a thermometer to check the water temperature. A thermostat for use with alcohol should be open completely at 160 degrees and for permanent anti-freeze it should be open at 180 degrees. If the thermostat opens too soon, the motor does not warm up quickly and operates too cool. Opening too late may cause overheating.

Another cause of inefficiency in a cooling system is loose and worn fan belts, Fig. 4, and misalignment between the belt pulleys, which causes early failure of the belt, Fig. 5. When a motor runs too cold, unburned gasoline works down into the crankcase and dilutes the oil, resulting in



① FAULTY COOLING SYSTEMS
NEED WATER OFTEN

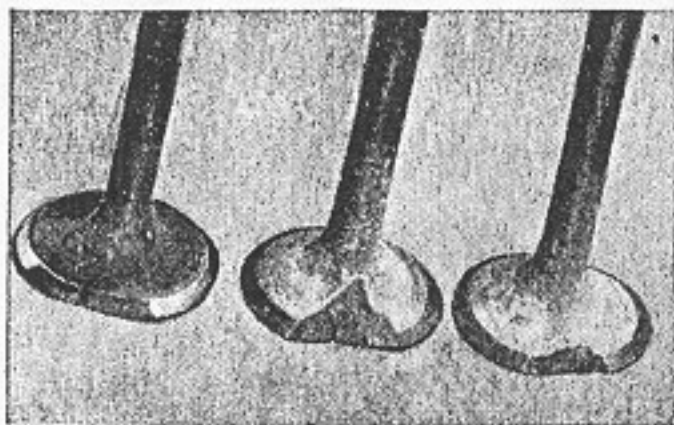


② DISCONNECT UPPER HOSE
TO REMOVE THERMOSTAT

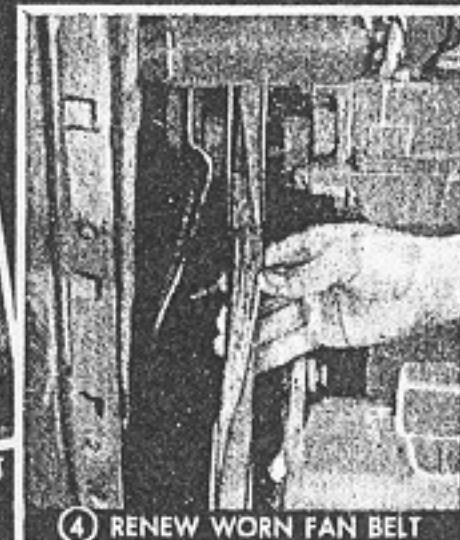
③ TESTING
THERMOSTAT
IN HOT WATER



⑥ BURNED VALVES



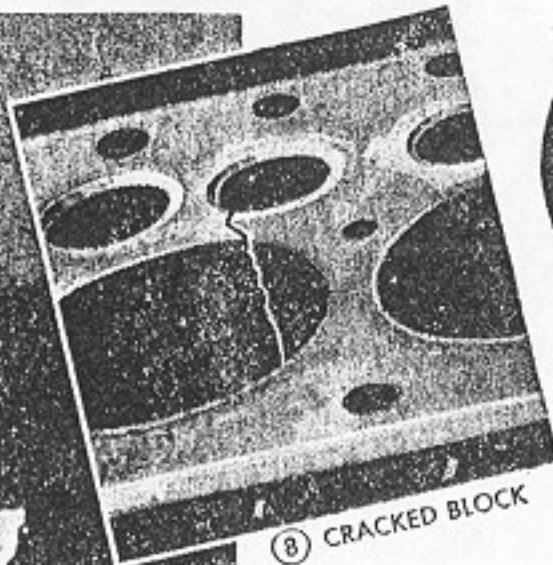
⑤ MISALIGNED FAN BELT



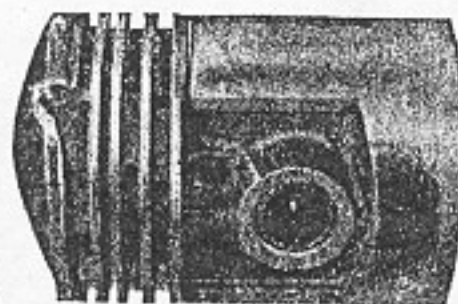
④ RENEW WORN FAN BELT



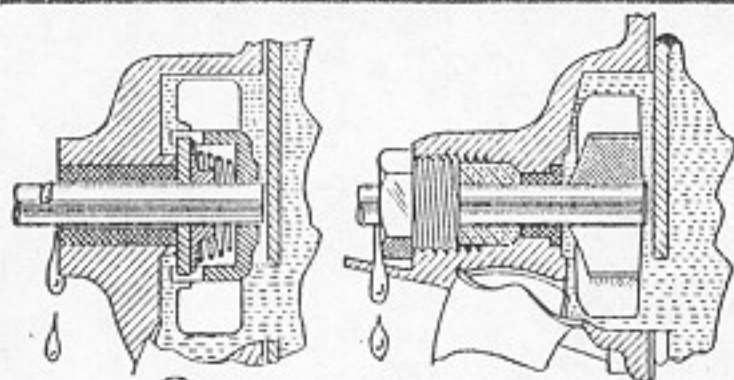
⑨ APPLYING CEMENT TO GASKET



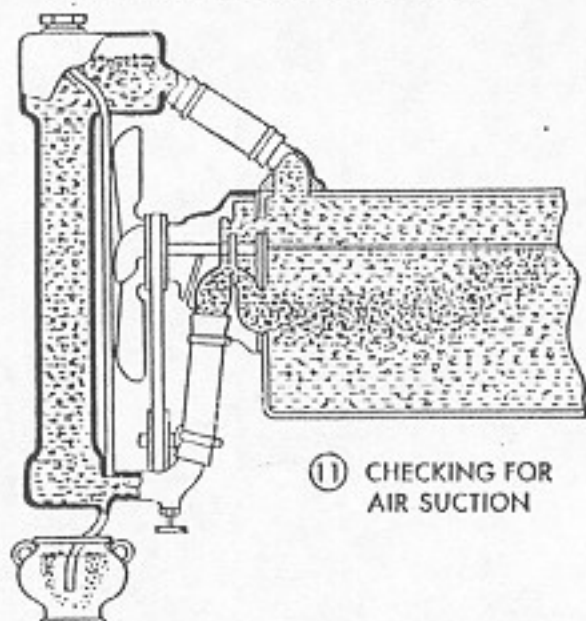
⑧ CRACKED BLOCK



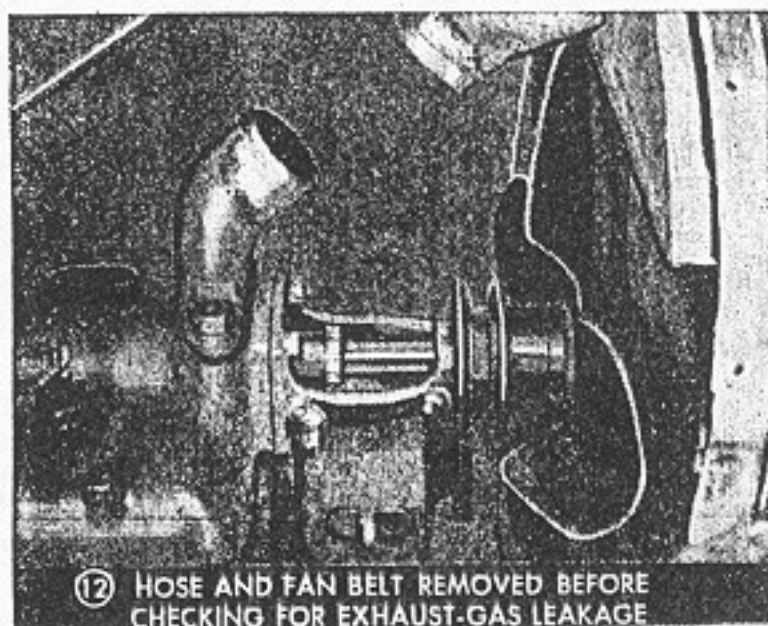
⑦ RUINED PISTONS



⑩ WHERE WATER PUMPS LEAK



⑪ CHECKING FOR AIR SUCTION

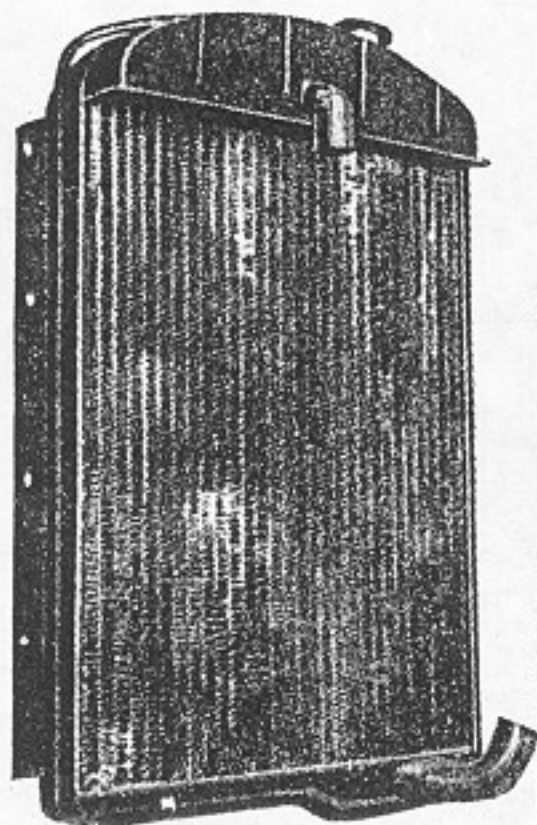


⑫ HOSE AND FAN BELT REMOVED BEFORE CHECKING FOR EXHAUST-GAS LEAKAGE

excessive wear and corrosion of vital parts such as pistons, wrist pins and bearings. On the other hand, distortion of metals from overheating, and reduction in the thickness of the oil film from high temperatures can be the cause of burned valves, Fig. 6, stuck piston rings and scored pistons, Fig. 7, and sometimes cracked blocks as in Fig. 8.

Still another common cause of trouble in a cooling system is a leaky water pump or lower hose connection. Fig. 10 shows where water pumps usually leak. But even more serious is the leakage of air into the cooling system. Constant introduction of air as a result of water-pump suction so aerates the coolant that it will increase in bulk, with the result that some will be lost through the overflow pipe. Another action resulting from the presence of air in the coolant is the extremely high rate of rusting in the cylinder block. To test for air leakage, be sure that the coolant level in the radiator is at normal height with sufficient room for expansion, and then place the radiator cap in position so that it is air tight. With a rubber tube attached to the lower end of the overflow pipe and placed in a jar of water, you are ready to test for air leakage as in Fig. 11. The motor should be operated at a rather fast speed until it is warmed up to proper operating temperature. Then, with no change in speed, see if air bubbles continue to rise in the jar of water. This indicates conclusively that an air leak exists. With the equipment attached, necessary corrections should be made on the water pump or loose connections until the trouble has been eliminated.

Another cause of corrosion is the seepage of exhaust gas from the combustion chamber into the coolant. To test for this condition, remove the fan belt and the upper hose as in Fig. 12 and adjust the water level in the cooling system so that it is just visible at the upper outlet from the motor. The thermostat should be removed. Then, by idling the motor and suddenly "gunning" it for very brief intervals, bubbles can be seen rising through the cool-



(13) LEAKY RADIATOR

liquid if there is an exhaust leak. Introducing a little oil into the carburetor to cause smoky exhaust will make the presence of exhaust gas in the coolant more conspicuous. While the leakage of exhaust into the cooling system is bad because of its highly corrosive effect, the loss of coolant into the engine, probably through the same leak, is also extremely destructive. In cases of this kind, new cylinder-head gaskets, if available, should be installed or the old ones, if in good condition, should be made tight with the use of gasket cement, Fig. 9. A common cause of leakage is unequal tension of the cylinder head bolts.

It's a simple matter for any car owner to service his own cooling system twice a year. Use of any of the well known radiator cleaning compounds, as in Fig. 14, is a



(14) IT'S EASY TO USE COOLING-SYSTEM CLEANERS

wise precaution. Be sure to follow the manufacturer's directions as to use. After the compound has remained in the system the specified time, remove the hose connections and allow the liquid to gush out for the greatest cleansing effect. Then flush out gently with a garden hose. Merely opening the petcock does not provide a sufficiently fast flow to carry away the foreign matter loosened by the cleaner. Looking closely at the radiator of any car that is a year or two old, it is not unusual to see white blotches on the fins as in Fig. 13. These blotches are lime deposits, each blotch indicating the presence of a leak in the core. Accordingly, when a cleaning agent is used in a radiator that has white blotches on it, it is not unlikely that leaks develop as a result of using the cleaner, although it did not cause the leaks. They were there previously, and were merely clogged with rust and lime.

AMERICAN COOKERY FEBRUARY, 1941

QUERY No. 6302. — "Will you please explain the difference between barley sugar and caramel."

Barley Sugar and Caramel

If cane sugar is heated carefully over low heat it will melt and become a liquid. In order to prevent burning it is necessary to stir the sugar constantly while the change is taking place. If the liquid is poured into a buttered pan and allowed to cool, it will become a clear, light brown sheet of what is known as "barley sugar." Crystals will not form again because during heating the

"water of crystallization" has been evaporated from the sugar. This barley sugar is the basis of the candies known as "brittles"; the melted sugar is poured over nuts, coconut or other additions when placed in the pan.

If the heating of the sugar is continued after the melting point is reached, more water is driven off and a substance formed known as "caramel." Hot water may be added to dissolve the caramel and sirup stored for later use. The caramel sirup is darker than the barley and has a distinctive flavor.



What a Compression Gauge Can Tell You

Conclusions that can be drawn from the chart (below) of a compression test which the writer made on his car:

No. 7 cylinder definitely was losing pressure. The oil seal in the second part of test increased the pressure only slightly, indicating that trouble is mostly in valves or perhaps the gasket.

No. 8 seems to have a valve or gasket loss, although not great. No. 1 cylinder, which made a good recovery when oil was introduced, apparently is losing pressure past the piston.

Gauge variation or carbon build-up may explain the fact that the average dry compression is higher than the 120 pounds specified for this engine as normal. Wet test was not made on cylinders that seemed okay on the first test.

Cylinder pressures developed in a car engine offer clues to trouble if you can read them.

CONSIDERING how little it costs and what it can tell you, a compression gauge is one of the best tools that a car owner can have. In skilled hands, it will point to such trouble-makers as:

- Sticking valves or worn valve seats.
- Worn or sticking piston rings.
- Scored cylinder walls or worn pistons.
- A blown cylinder-head gasket or loose head bolts.
- Sizable carbon deposits in the combustion chambers or on the tops of the pistons.

The object of a compression test is to measure the pressure developed in each cylinder by the movement of the piston. The gauge gives readings in pounds per square inch. Using one may save you money by revealing a fault while it still can be corrected easily.

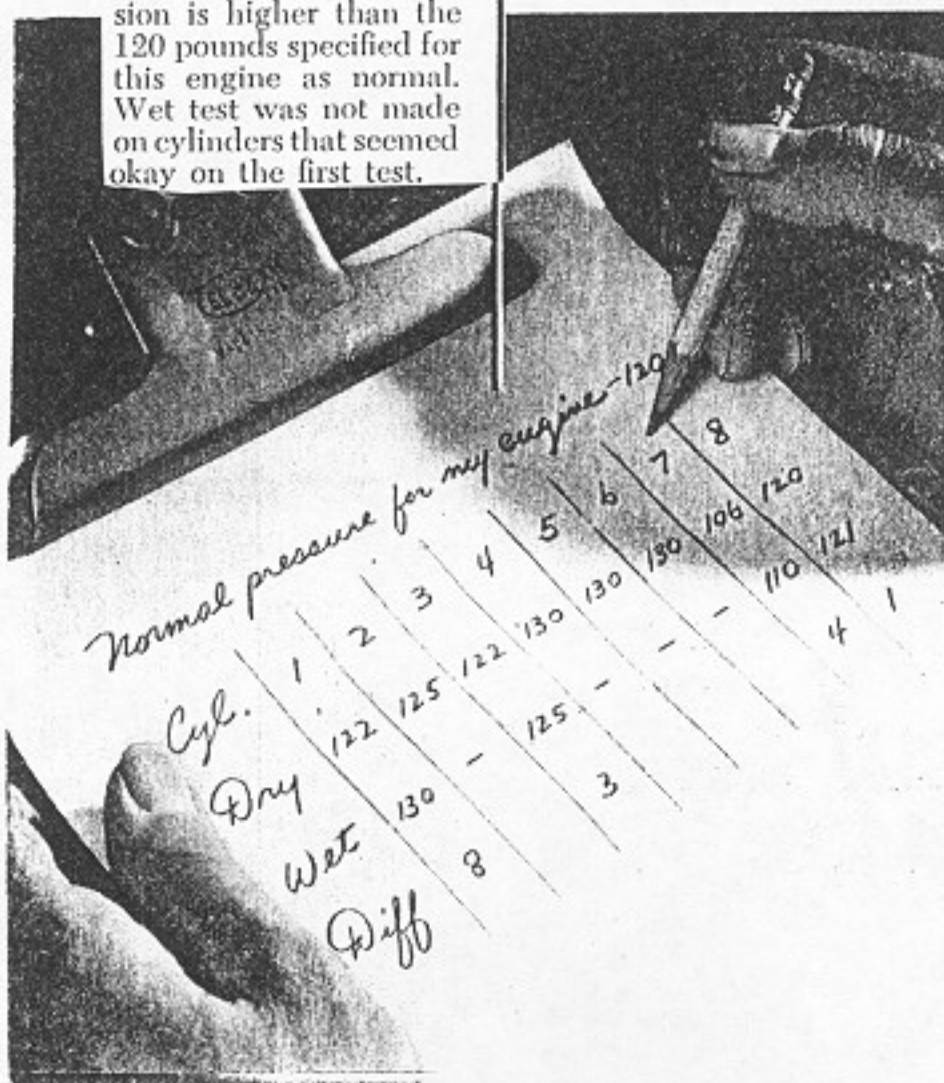
To run a test, first warm up the engine oil completely, perhaps by taking the car for a drive. Be sure, too, that the battery is definitely well charged.

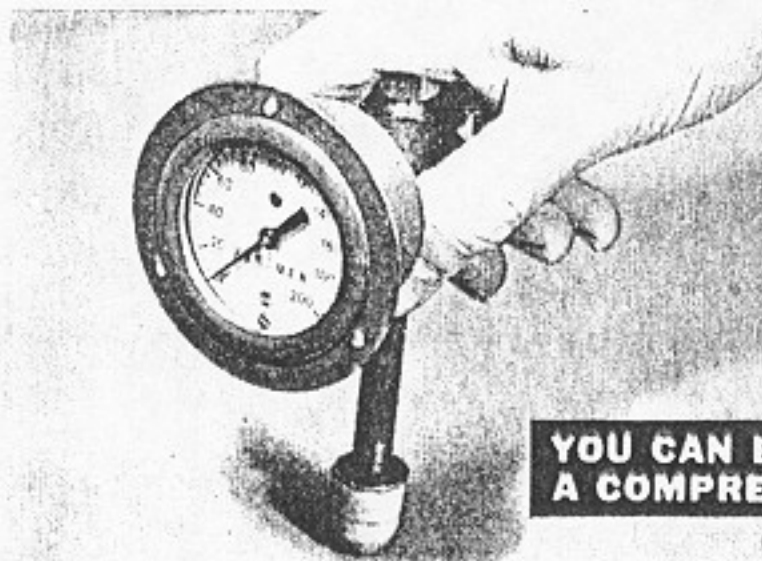
Blow all dirt and dust from around the spark plugs and remove the plugs and their gaskets.

Disconnect the high-tension cable that runs from the coil to the center terminal of the distributor cap. Usually the throttle and choke valve should be open, although directions with some commercial gauges may say to keep the throttle closed.

Connect the compression gauge to the spark-plug hole of the first cylinder. If the gauge has a rubber-cone tip, simply press the cone firmly and squarely into the hole.

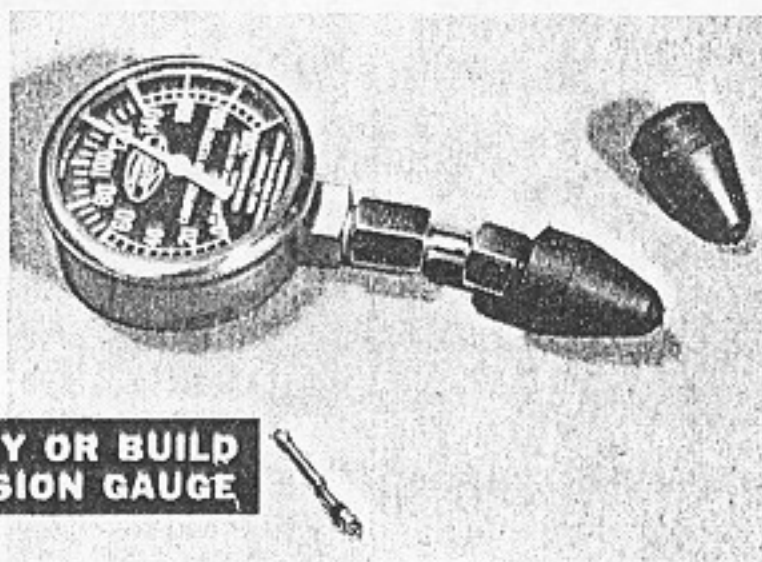
Operate the car starter, turning the engine over several times until no further increase in gauge pressure is seen. If your starter switch is solenoid-operated and you don't have a remote-control



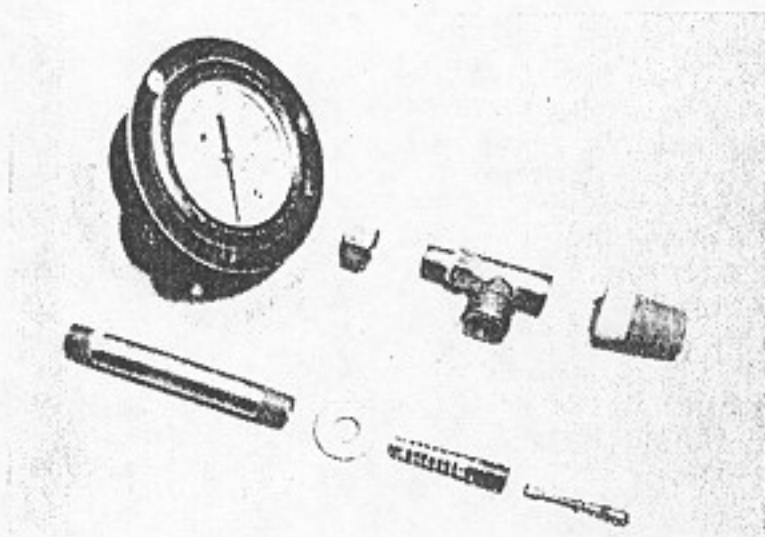


YOU CAN BUY OR BUILD A COMPRESSION GAUGE

Homemade gauge makes use of an air gauge with a maximum reading of 200 pounds. Hold it this way to take a compression reading, thrusting the rubber nozzle into the spark-plug hole. Photo sequence below shows how it's made.



Commercial gauge like this is available from mail-order or auto-supply houses for around \$5. Valve in stem keeps needle at maximum reading until released. Long-stem gauges are made for engines with hard-to-reach plug holes.



1 Parts used include the air gauge, which happened to be panel-mounting type with a threaded pipe connection at rear rather than at side; a $\frac{1}{8}$ " pipe tee capped at one end (an elbow would have done), a rubber stopper, a short $\frac{1}{8}$ " pipe nipple, a washer, and a valve assembly taken from an inner tube. Grooved portion of valve body should be filed down as necessary to fit inside the pipe nipple.

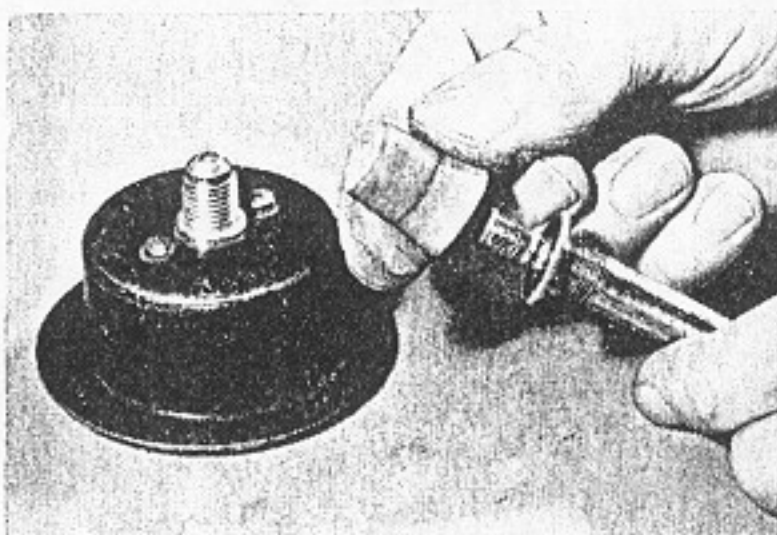
jumper, get someone to press the button on your signal.

Record the readings on a sheet of paper as you progress. Notice how much pressure is indicated for the *first* compression stroke of the piston. Jot down the maximum pressure developed by the cylinder—the reading beyond which the gauge needle will not move.

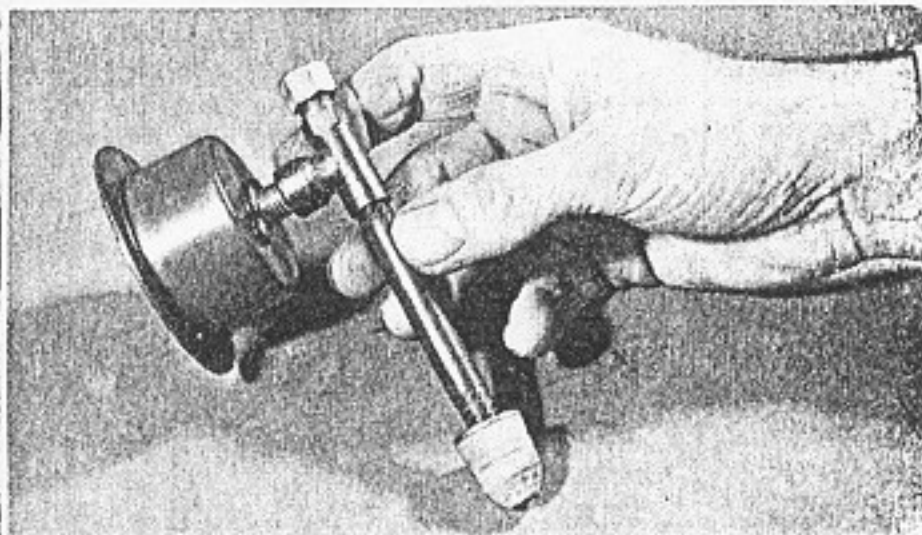
Release the pressure in the gauge by depressing the valve stem and test all cylinders the same way, writing down the maximum reading for each.

What the figures mean. Maximum cylinder pressure varies among different makes and models of cars. You can learn the normal cylinder pressure for your car from the manufacturer's specifications.

If the pressure in each cylinder is close to that recommended as normal, or if all



2 How it's assembled. Tin outside of valve body and inside of nipple near one end, insert valve body half its length and solder the two together. File down valve-body shoulder so washer can be pressed over it as above. Drill stopper lengthwise to turn up on valve.



3 Completed gauge. Notice how bottom of stopper has been shaped to fit into spark-plug hole. This can be done by filing. For a gauge with connection at side, run nipple straight without tee or elbow. Some engines require a longer stem, perhaps offset at angle.

cylinder readings are about the same (in case you don't know the recommended pressure), everything is probably fine.

If the pressure is definitely lower or higher than the recommended pressure, but there still is no variation of more than a few pounds among the cylinders, you still have no particular cause for worry.

But if one or more cylinders read decidedly low by comparison with other cylinders, all is not well. Suppose that one cylinder shows up low in a test of an eight-cylinder engine. Add together the pressures for the other seven and divide the total by seven to get an average. Subtract the low figure from the average. If the difference is greater than 10, you can expect to find trouble.

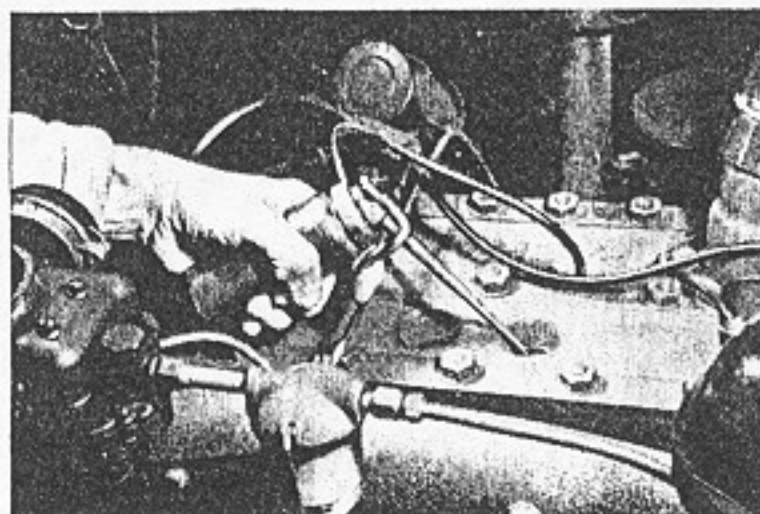
Now run a second test by squirting about a tablespoon of medium or heavy engine oil into the spark-plug holes of the cylinders which showed decidedly low pressures on the first test. Turn the engine over a few times to draw oil down around the pistons and act as a compression seal.

Using the gauge as you did before, take a pressure reading of each cylinder into which you squirted oil.

Interpreting the figures. Now by studying and comparing the pressure figures, you can learn a lot about the engine.

If on the dry test, the pressure in a cylinder went up only a piddling 15 pounds or so on the first piston stroke and then, on succeeding strokes, built up slowly to the maximum, you can suspect that the valves were sticking or the valve seats are in poor condition.

Adding oil to a cylinder nearly always



Squirting oil into cylinder provides seal for second set of compression readings. Crank engine a few times to distribute oil.

causes *some* pressure increase. If the pressure in a low cylinder jumps close to the average on the wet test, you know that compression was being chiefly lost past the piston. This may be the result of worn rings, gummed rings sticking in their grooves, a scored cylinder wall or a worn piston. Sometimes the use of a solvent will restore compression by freeing stuck rings.

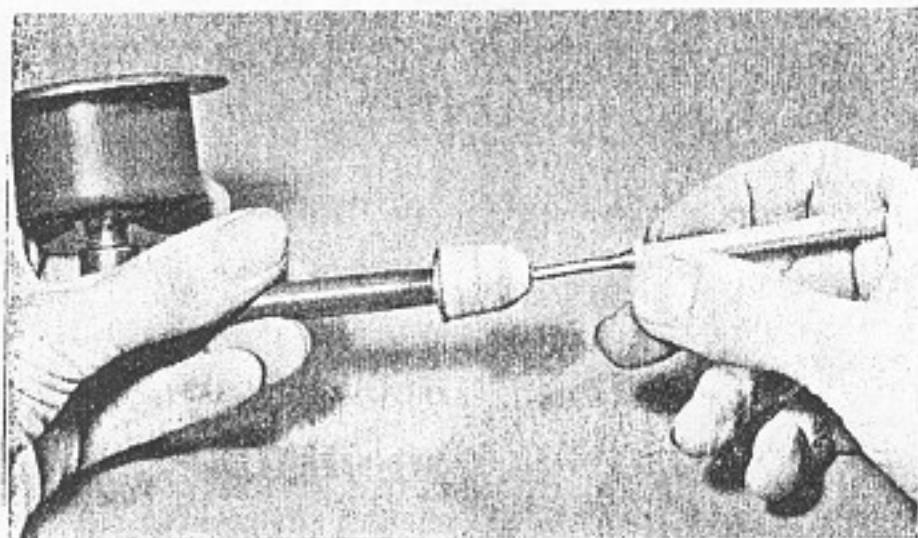
If a low-reading cylinder comes up only slightly when oil is added, the trouble probably lies in the valves or the head gasket. Adjusting tappet clearance or tightening the head bolts may cure the trouble. Or a valve-grinding job may be required.

If the oil causes a marked increase in pressure but the reading still is decidedly below average, some of the leakage is past the piston, some through the valves or around the gasket.

Two side-by-side cylinders showing low pressures suggest that a gasket leak is located between them. Sometimes tightening the head bolts will bring the pressure up.

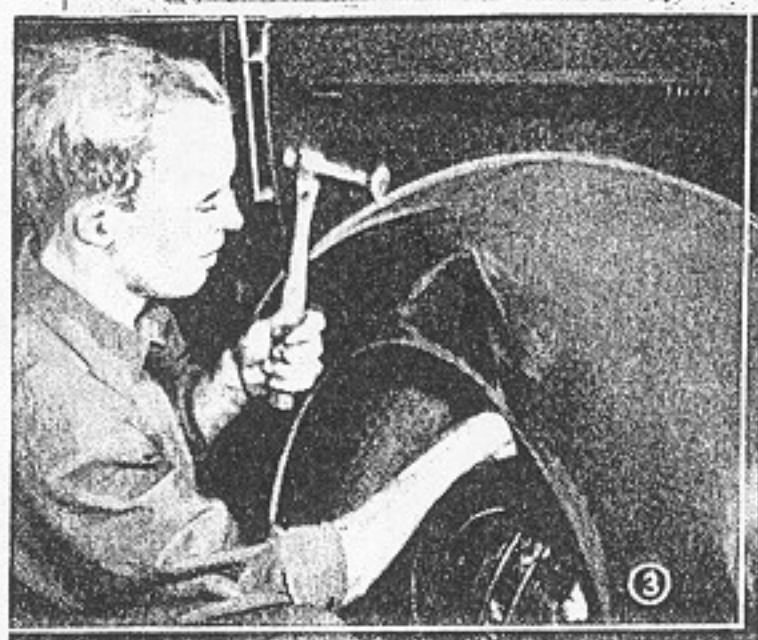
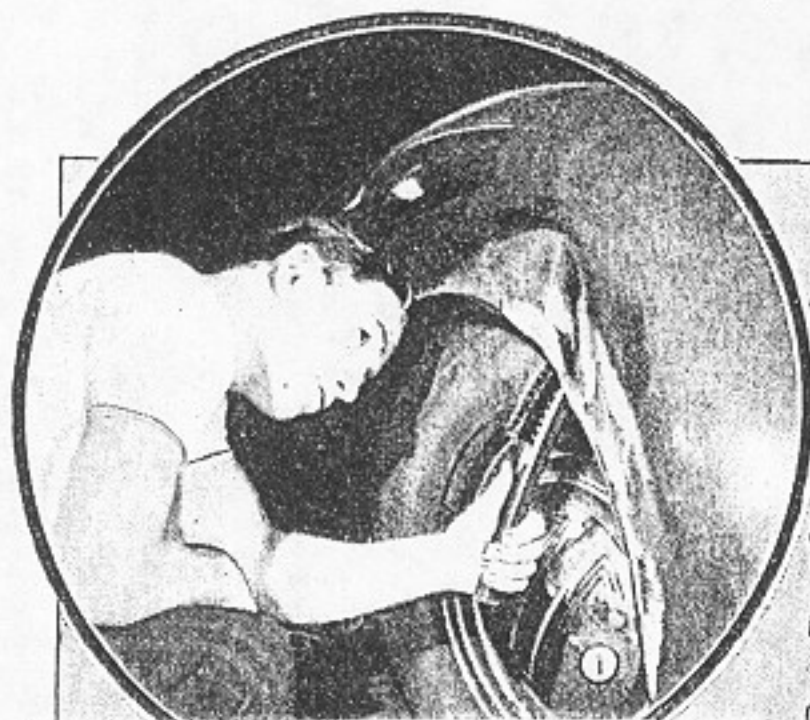
Higher pressures than those specified for an engine may indicate that large deposits of carbon in the combustion chambers or on the piston tops are reducing combustion-chamber volume. Too much crankcase oil working into cylinders also can cause a pressure increase. Adding more oil through the plug holes, therefore, could not be expected to increase the pressure. If the engine is pinging, try retarding the spark or using a gasoline of higher octane rating.

Compression tests depend on a good wear-in of the piston rings. So they may not be accurate on a new engine, one recently rebuilt or one having new rings.—*Walter E. Burton, Akron.*



4 Slender tool depresses valve core to release air after gauge has been used. Test the gauge for air leaks on a service-station air hose. If gauge is to be used to measure compression in comparison with specified pressure, check it against a standard gauge.

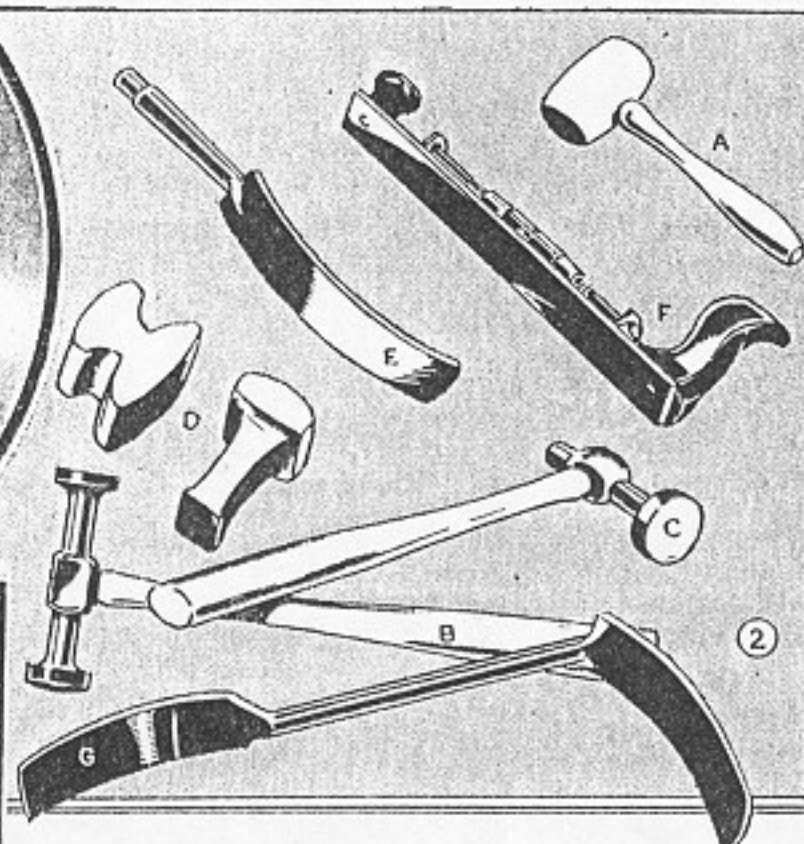
OUT WITH



It is a simple job to remove small dents quickly with a dinging hammer and a dolly



Dinging will smooth up the job after all large dents have been removed



By RORY O'SHANE

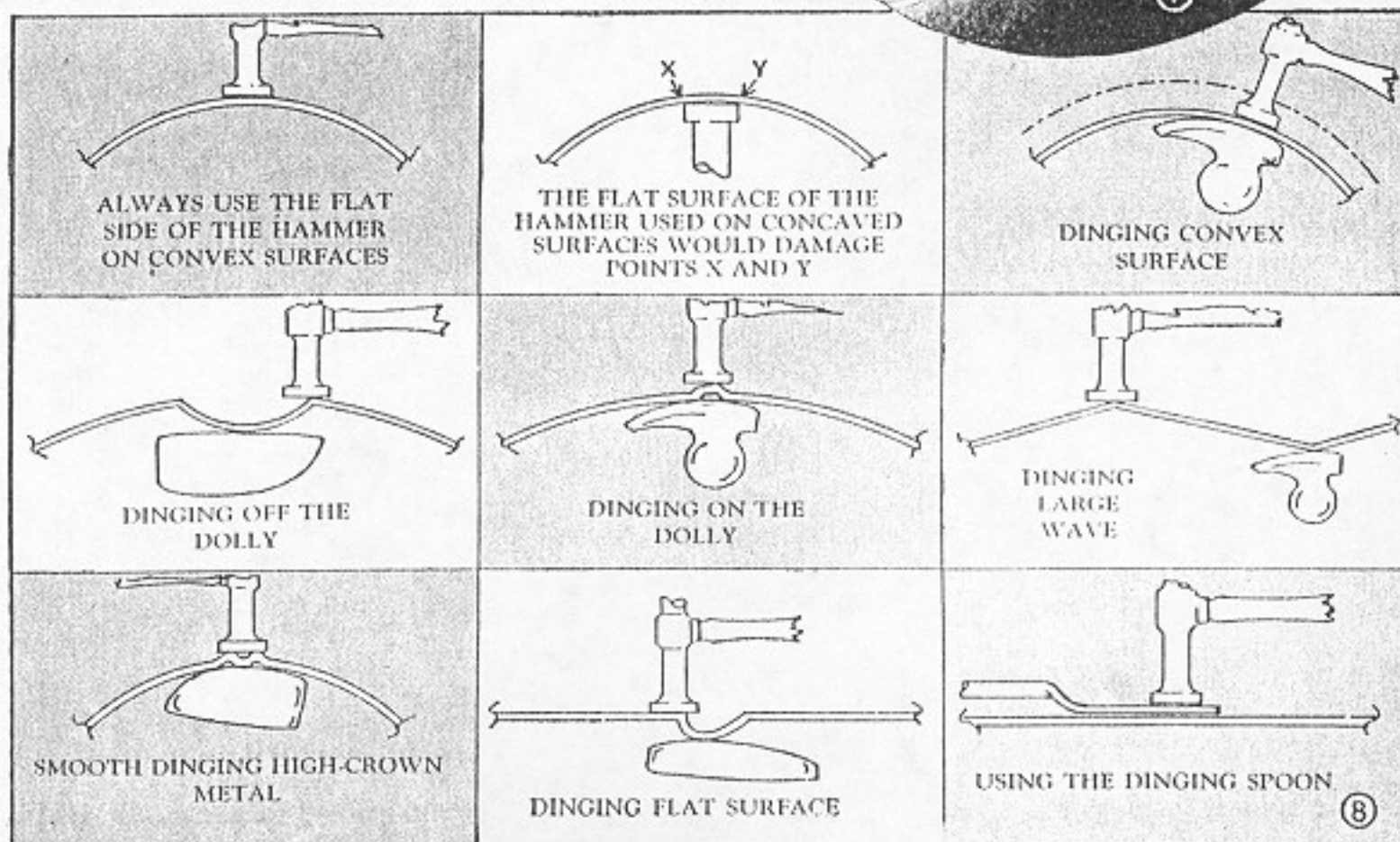
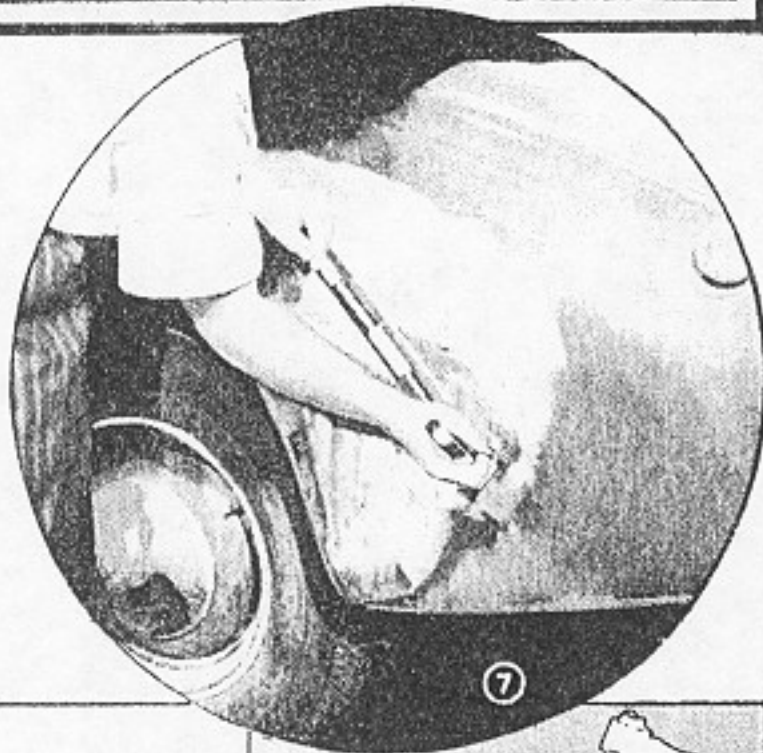
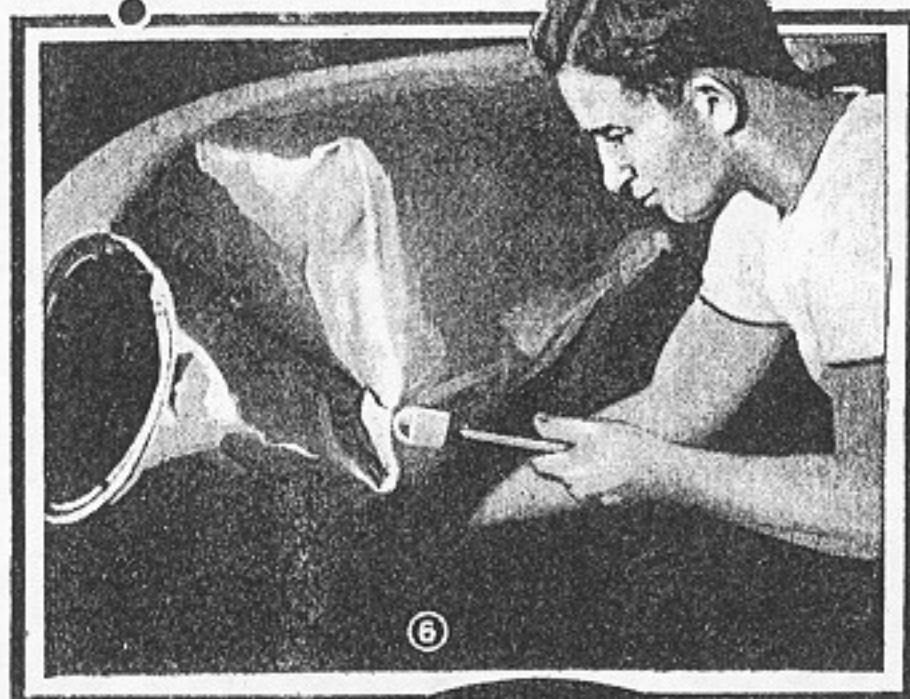
FEW motorists think of repairing a damaged fender, yet it's not so difficult if you have some spare time and exercise a little patience. Your tools, Fig. 2, should include a bumping hammer, A, for heavy work, a dinging hammer, B, for light work, and a half-hammer, C, for use where space is limited. Be sure to get several dolly blocks, D, and an assortment of dinging spoons, G and E. The former are used primarily in raising low metal during the dinging process, while the latter act as pads between hammer and metal in transferring the force of the blow to the fender without marring its surface. An adjustable file, F, completes the list.

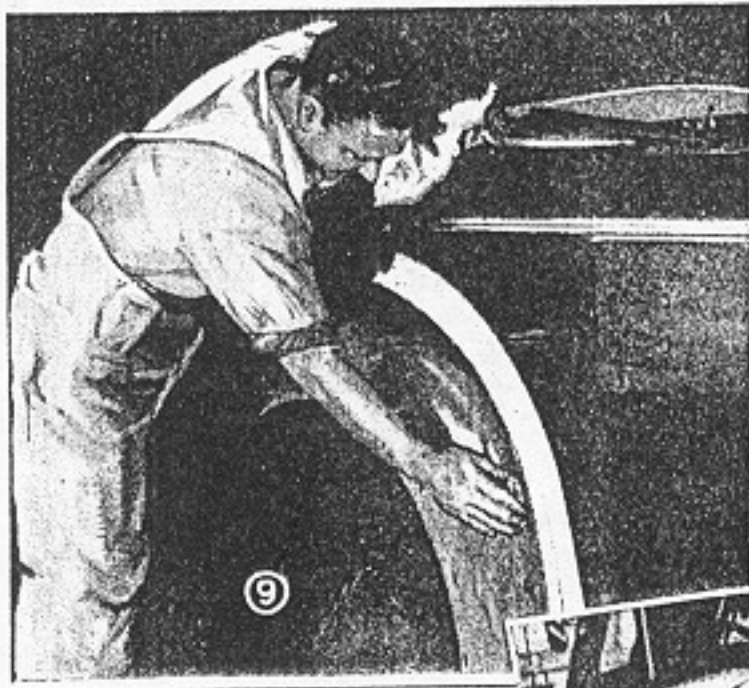
The first step is to remove all dirt from the top side of the fender, and then scrape the underside free of tar and clinging particles with a wire brush, Fig. 1. Next, spread a thin film of oil over both sides of the fender. It will reflect light into hidden indentations, and also protect the paint while the fender is being repaired. A basic rule of fender repair is that the dent must come out the way it went in. Though no two damaged fenders look alike, they are nothing more than a differently patterned series of ridges and valleys. Therefore, determine the path of the force that caused the pattern. In repairing, work from the last buckled ridge back to the point of first

the DENTS!

contact. The larger dents are removed first, Fig. 6. This process is called bumping. Never try to bump out small dents. If the fender is folded into tight "accordion" layers, bring these out by pulling on the fender or by prying the folds open with a dinging spoon.

Place a dinging spoon on the first ridge and strike the spoon a sharp blow with the bumping hammer. Never hammer at an angle; bring the hammer squarely down on the ridge. This starts the high metal down. Then start on the next high ridge and go through the same process until all the high metal has been beaten to the contour of the fender. The general rule for using a dolly is to hold it against the low spot while you hammer at the high spot. Figs. 3 and 8. Hammer off the dolly rather than squarely on it to prevent the metal from stretching. In the case of a deep, narrow dent, remember to place the dolly directly underneath, exerting a vertical pressure while you hammer at the rim of the dent. When the dent is broad and shallow, place a dolly block opposite the side on which the dent was made and bump at the outer edges, working in toward the center. Al-



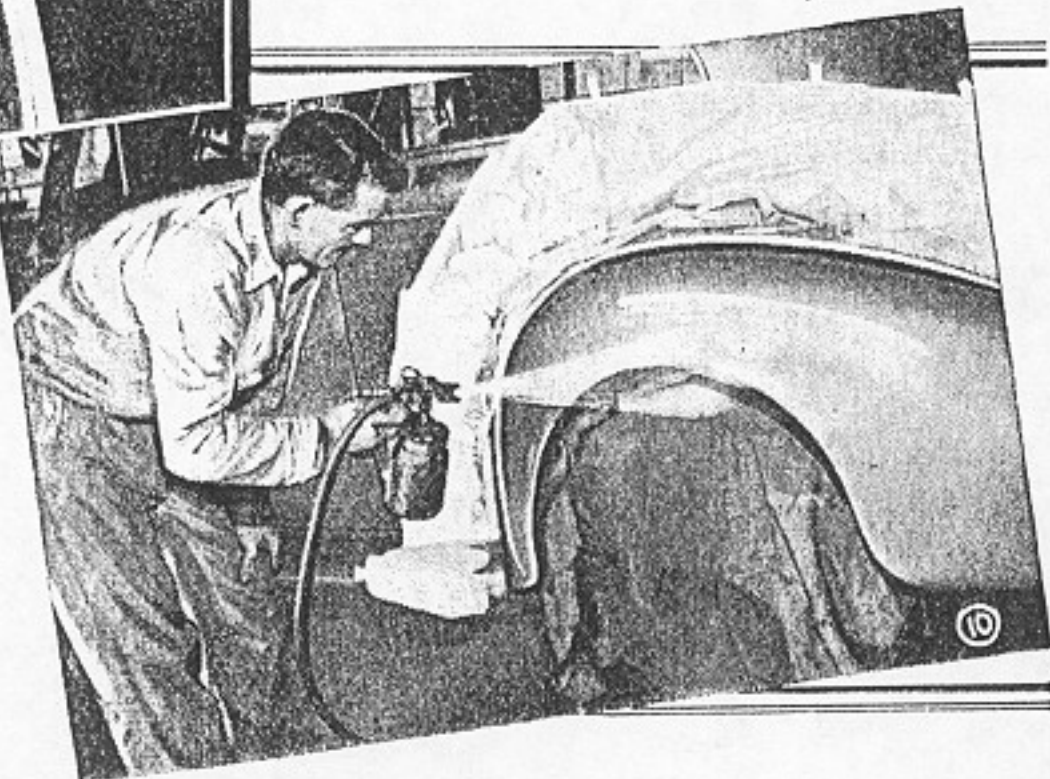


ways use a dolly block having the same contour as that of the fender before it was damaged. Several light blows are better than a few heavy ones. Be sure your hammer and dolly surfaces are free of scratches and nicks to avoid scarring the fender surface. When the high metal has been backed down to normal, the low metal can be sprung into position. It will go quite easily because the removal of the high metal has eliminated most of the strains on the fender. All you have to do is bump lightly from underneath with a dolly block. If you fail to bump systematically, you may bring the high metal down farther than it should go. A few careless blows may mean extra hours of work.

After all the larger dents have been smoothed out, dinging to remove the smaller dents is next, Fig. 5. The principle behind it is similar to working metal on an anvil, the dolly block being the anvil. The diagrams in Fig. 8 illustrate the principle. A dinging hammer should not be gripped too tightly, but should be swung with enough flexibility so it will rebound to the starting position. Strike with the entire head of the hammer rather than with the edge. Use the crowned face on concave surfaces and the flat face on convex surfaces. A dinging spoon should be balanced loosely in the hand. The hammer blows should be directly on the ridge of the dent being dinged.

After the bumping and dinging processes have brought the fender into normal shape,

it is ready for finishing and painting. Sight across the back or front of the car to see if the fenders line up evenly. If both have been damaged, compare fenders with a car of similar make and age. You can bring a fender that is out of line back to its original position with a fender jack or by heating the brace. Though the fender may now seem perfectly smooth, slight irregularities still exist. The metal finishing operation will take care of this. The defects may

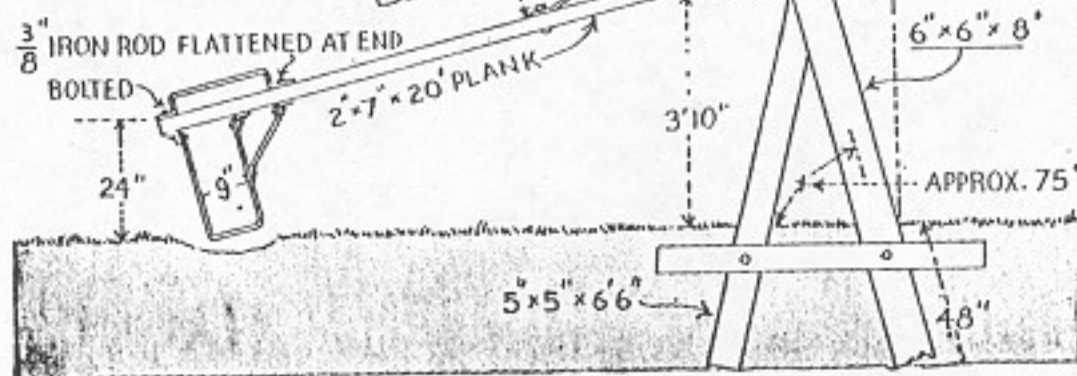
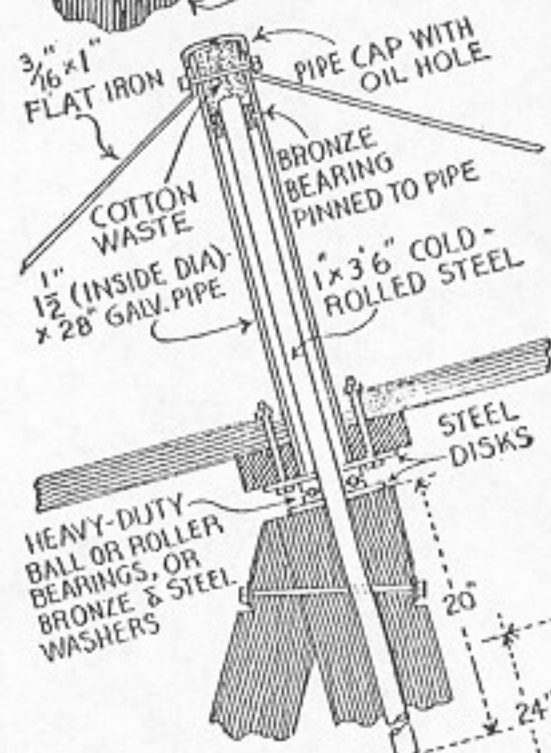
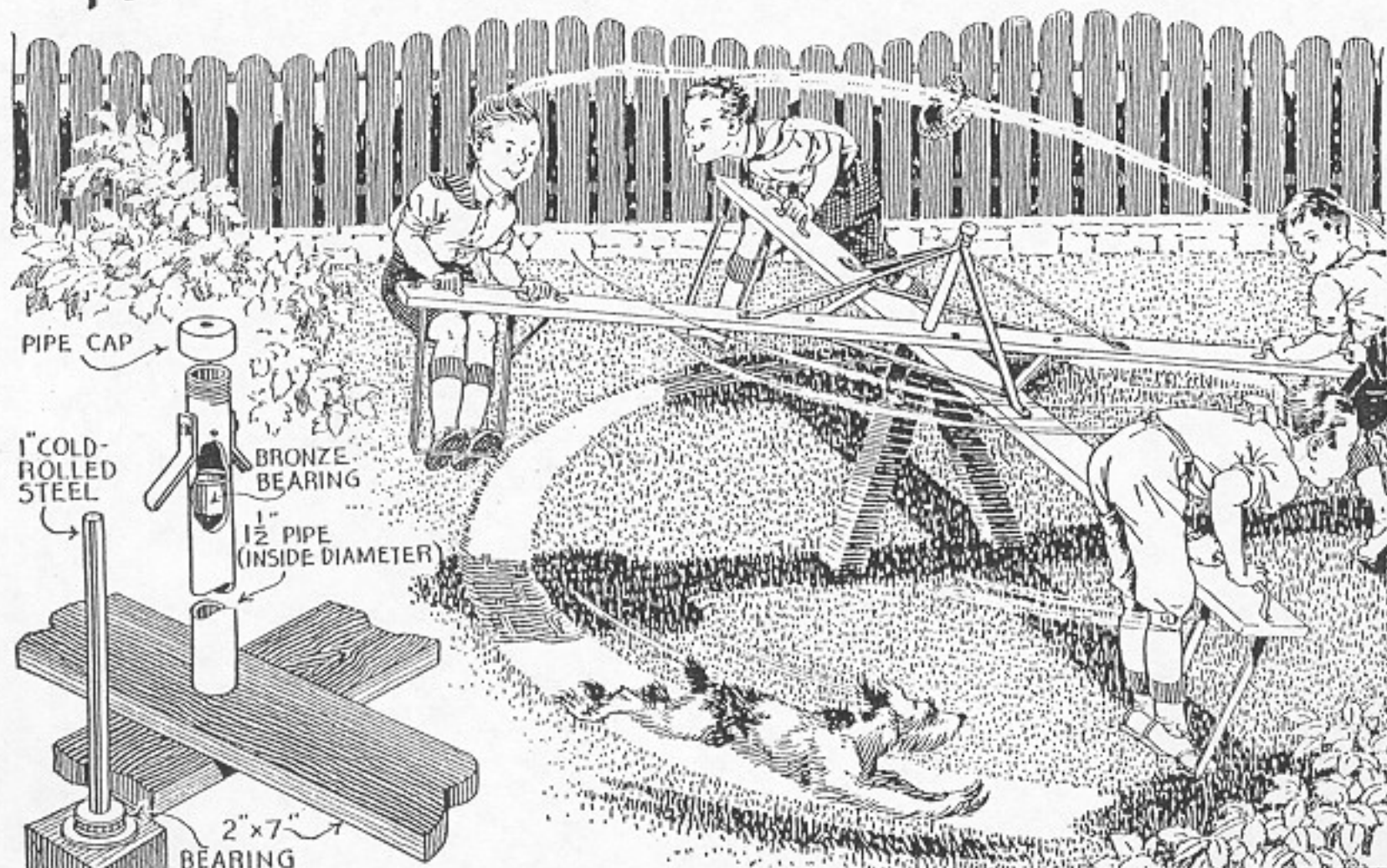


be detected by holding a long piece of chalk flat against the damaged portion and rubbing up and down. The high spots will be white and the low spots will be dark, Fig. 4. The fingers alone, Fig. 9, are not sensitive enough to find the irregularities. The correct way is to lower the elbow, lay the palm and fingers flat against the fender, and rub the hand up and down over the damaged area. Remove the small dents with a hammer and dolly.

Now use the adjustable file to smooth the surface as in Fig. 7. However, be careful not to file away too much metal. Pulling the file evenly along the contours of the fender will remove the tops of the high spots thus revealing the final dents to be dinged away. Use the file again to prepare the surface for sanding.

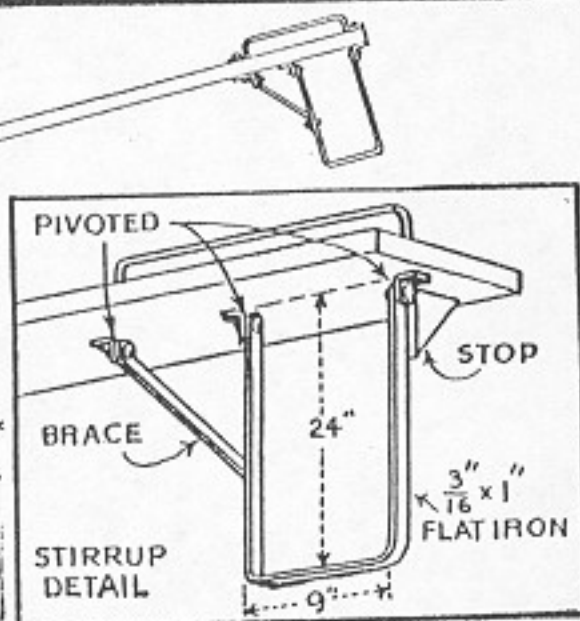
Wetting the sandpaper with gasoline will clear the surface of dirt and polish. When it shines like new, it is ready for painting, Fig. 10. First comes a coat of primer. After this, brush or spray on three or four coats of lacquer about 20 min. apart. When the final coat is dry, sand it with fine-grained sandpaper. Then apply a good body polish.

"Ocean Roll" MERRY-GO-ROUND

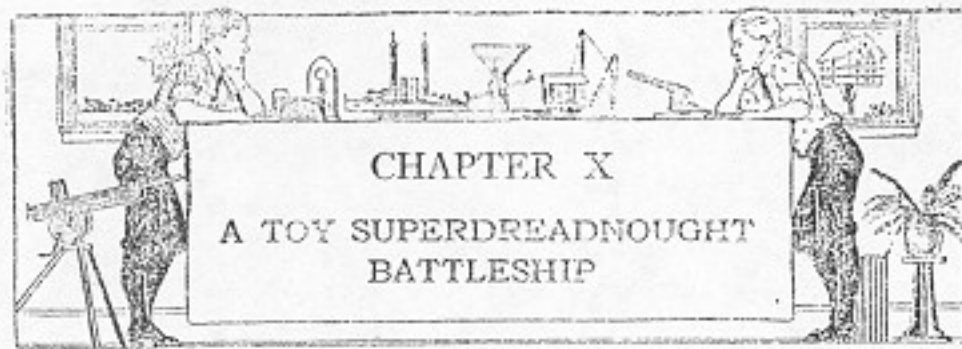


Whirling around on this merry-go-round gives you a sensation somewhat like that on a boat in a heavy roll. The axis is set at an angle to give an up-and-down movement while rotating. There's a handgrip and a stirrup on each crosspiece, the stirrup being pivoted so that it will swing back and not injure anyone who might accidentally fall in its path at the low point. A block in front of each stirrup keeps it from swinging forward too far. Weight of riders traveling from the high to the low point helps to keep the thing moving and each one has to push only about one quarter of a turn before he hops on.

Popular Mechanics 1944



CARPENTRY AND MECHANICS FOR BOYS
1918



To make a model that would be an exact reproduction of a modern battleship, you would not only have to possess a set of scale drawings of the ship, but an abundance of patience, and a willingness to devote lots of time to the work. The author would be glad if you could make an exact model, because he knows that you would get a great deal of enjoyment and practical experience out of the work, but he suggests that your first model be simple. You can elaborate upon a second model as much as you please.

The way to make a simplified model of a battleship, building, piece of machinery, or any other structure, is to get a picture of it, or to look upon the object itself, and pick out the half dozen or so parts which determine its contour; then reproduce these parts in as nearly the correct proportion as you can. Take the author's model, shown in the photograph of Fig. 251, for example. The essential parts are not many. They are the *hull*, *deck*, *masts*, *funnels*, *main-battery guns* and *turrets*, and the *secondary-battery guns* below the deck. The *deck-rails*, *fighting-tops*, and *wireless aerial* might be omitted without destroying the lines which give the ship its form. Details other than those shown upon the model illustrated can be added if you wish to spend more time upon the work.

Materials. The best material for model making is white pine, but cypress, spruce, or any other soft wood, will serve the purpose. For the hull of the battleship model shown in Fig. 251 a piece of 2 by 4 is of the right width and thickness. The funnels, turrets, and fighting-tops also can be cut out of a 2 by 4. A board $\frac{3}{8}$ inch thick is required for the *superstructure-deck*. The masts require a narrow strip of *wire cloth* with $\frac{1}{4}$ -inch mesh, and four spools. The deck

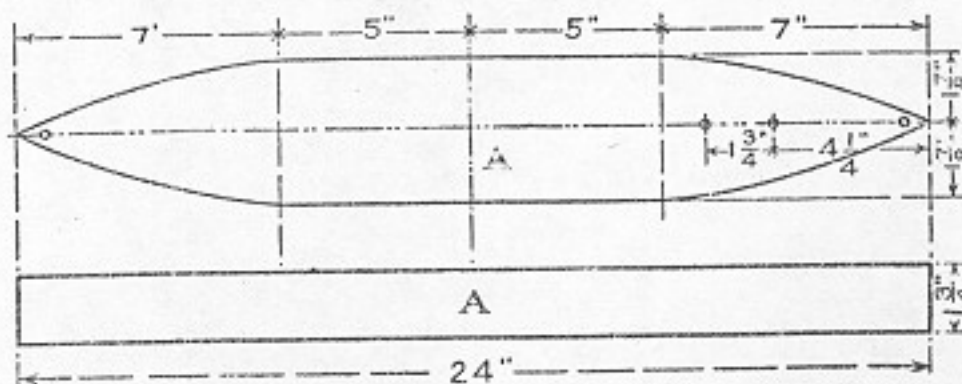


FIG. 252. — Plan and Side Elevation of Hull

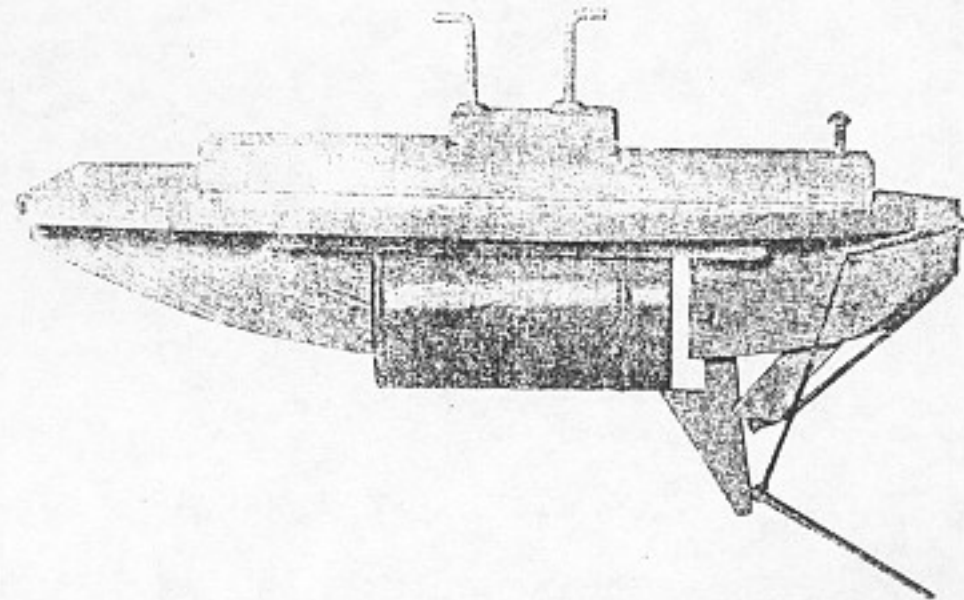


Fig. 258. — A TOY SUBMARINE THAT DIVES THEN RISES TO THE WATER'S SURFACE (See Chapter 11).

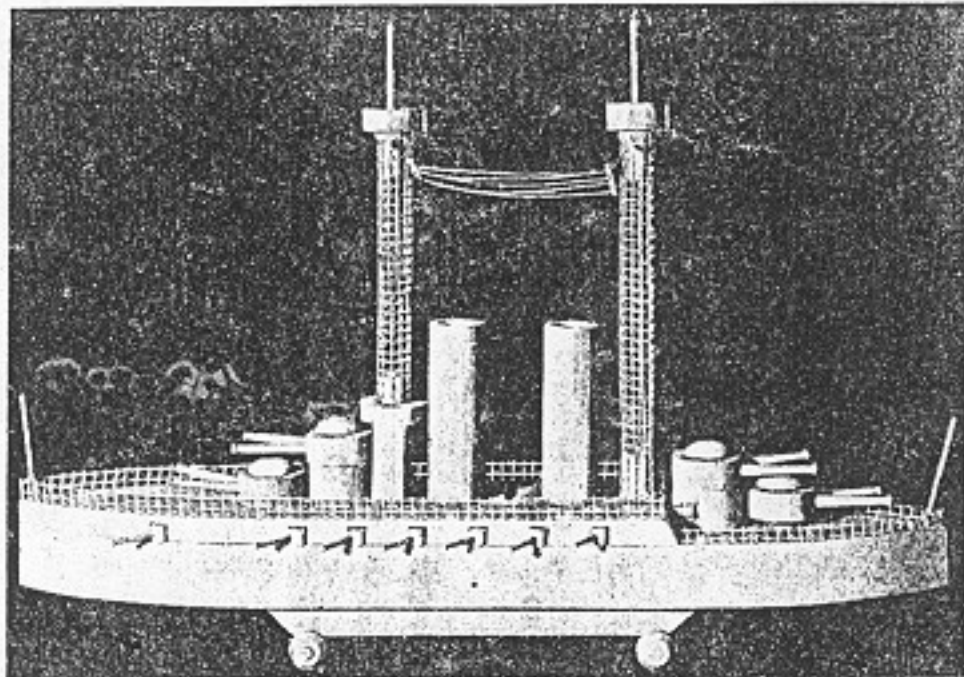


Fig. 251. — A SUPERDREADNOUGHT TOY BATTLESHIP (See Chapter 10).

rails are also made of wire cloth. Spools are used for wheels to mount the model on. The guns are cut from dowel-sticks $\frac{1}{8}$ inch and $\frac{1}{4}$ inch in diameter, the small *gun mounts* are cut from a $\frac{3}{8}$ -inch dowel-stick. The pins connecting the various parts are cut from $\frac{1}{4}$ -inch dowel-sticks. *Button-moulds* $1\frac{1}{4}$ inches in diameter fit over the ends of the gun turret *pivots*.

Figure 252 shows a plan and side elevation of

The **Hull**, with all of the dimensions necessary for cutting it out. Figure 253 shows the completed hull. The curves of the ends should be alike, and the best way to get them alike is to draw a *center-line* lengthwise, and another center-line crosswise of the block; then mark out one-half of the outline of one side, drawing the straight line with a ruler, the curved line freehand. Trace this much upon tissue-paper, reverse the paper, and transfer the line each side of the center-lines, to complete the outline. First, cut out the block roughly with a saw, then finish up close to the outline with a plane, and sandpaper the edges smooth.

The **Superstructure-Deck** (B, Figs. 254 and 255) may

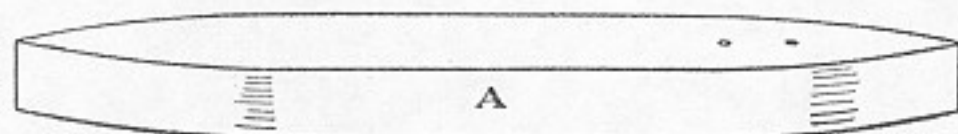


FIG. 253. — The Completed Hull

be marked out by placing the hull block upon a board $\frac{5}{8}$ inch thick, and marking out around its sides. The deck

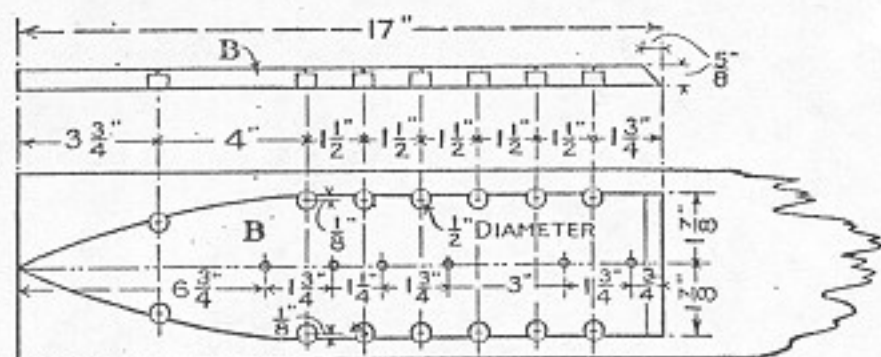


FIG. 254. — Plan and Side Elevation of Superstructure-Deck

piece is a trifle more than two-thirds of the length of the hull. The dimensions are on the diagrams (Fig. 254). Openings for the guns must be cut in the deck piece along the side edges. The openings are made by boring $\frac{1}{2}$ -inch holes $\frac{1}{2}$ inch deep (Figs. 251 and 255). They are located in Fig. 254. The centers are placed $\frac{1}{8}$ inch inside of the

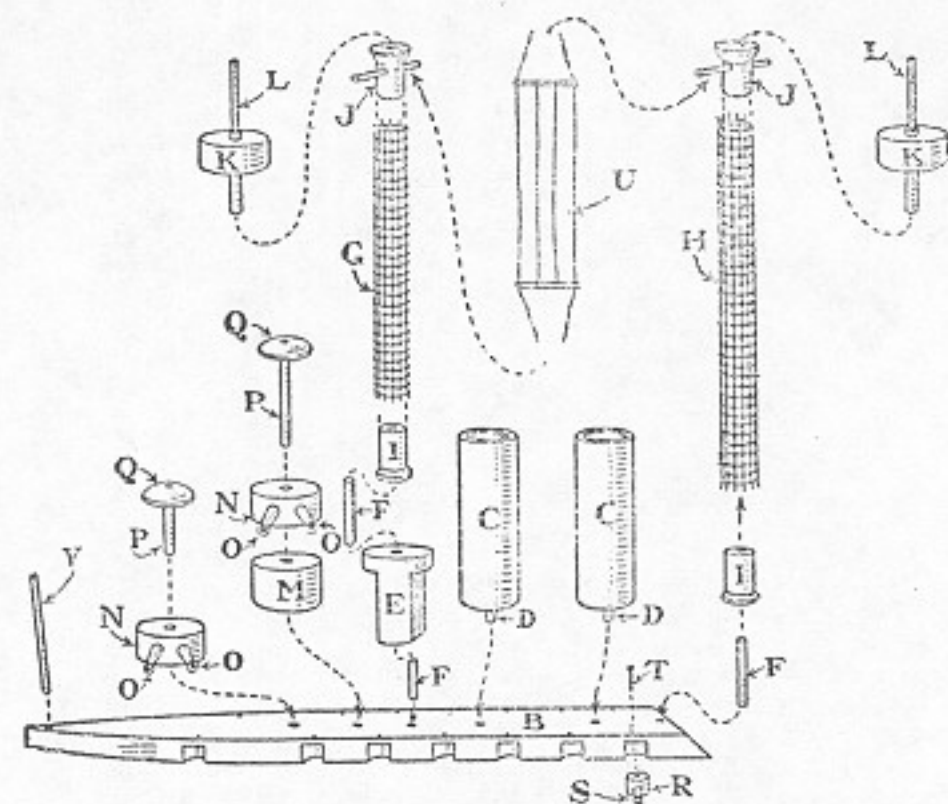


FIG. 255. — Detail Showing How the Superstructure-Deck, Funnels, Masts, Fighting-Tops, Gun-Turrets, and Wireless Aerial are Assembled

edges, so that brads can be driven through the centers for pivots for the guns. Bore the holes before cutting out piece *B*, so there will be no danger of splitting the edges. Be careful to bore all holes of equal depth.

Funnels C, conning-tower E, fighting-tops K, turret bases M, and turrets N (Fig. 255) are most easily prepared as shown in Figs. 256 and 257. If you can get round sticks of this

diameter — rug-poles or portiere poles, — use them; otherwise, plane up two blocks, one $1\frac{1}{2}$ inches square, the other $1\frac{3}{4}$ inches square, describe a circle with the given radii upon the ends of the blocks, and whittle or plane the edges until the blocks are round. Finish up the surfaces with sandpaper. With the blocks prepared, it is an easy matter to saw them up to the lengths required.

The tops of

The Funnels will look better if bored out for a depth of $\frac{1}{2}$ inch or so (Fig. 255). Bore the holes before rounding the block the funnels are to be cut out of, to prevent splitting. The funnels are fastened to the deck with dowel-pins *D* (Fig. 255). Bore the pin holes in the deck where located in Fig. 254, and in the center of the funnel ends. Coat the dowel-pins and funnel ends the dowel-pins into the holes.

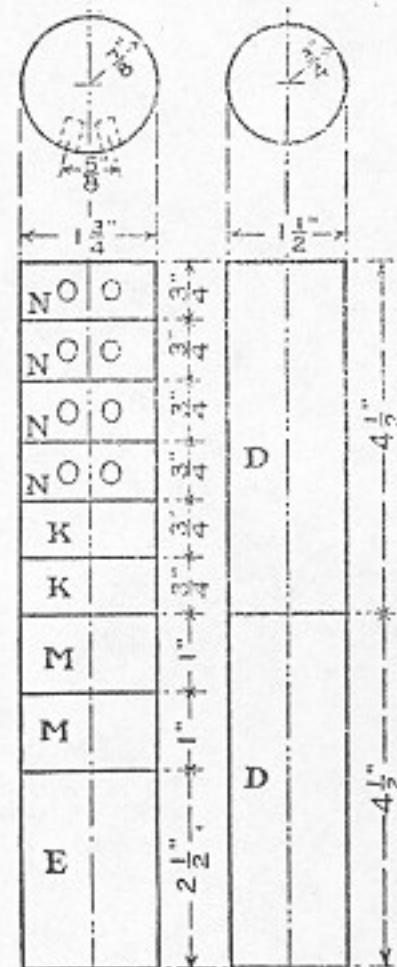


FIG. 257 FIG. 256

FIG. 256. — Detail of Funnels

FIG. 257. — Detail of Conning-Tower, Fighting-Tops, Turret Bases and Turret

the dowel-pins and funnel ends with glue, before driving the dowel-pins into the holes.

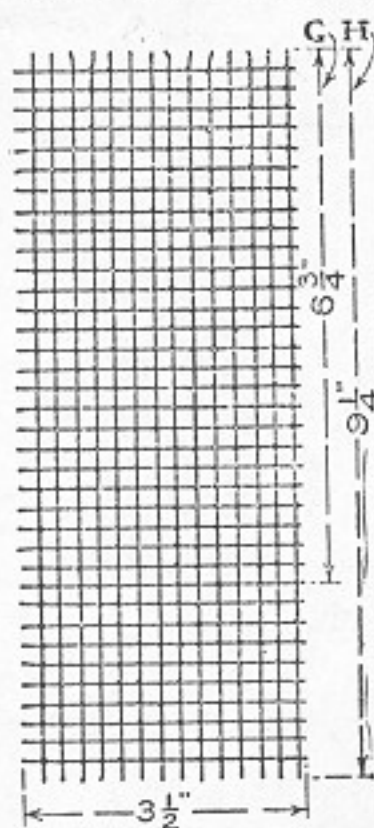


FIG. 258. — Pattern for Cutting Wire Cloth for Masts

Flatten two opposite sides of block *E* (Fig. 257) for

The Conning-Tower, by cutting away a section of each side, as shown in Fig. 255. Peg this block to the deck with a dowl-pin driven into a hole bored at the point located in Fig. 254.

The Masts are built up of strips of wire cloth (*G* and *H*, (Fig. 258) rolled into cylinders with a spool inserted in each end (*I* and *J*, Fig. 255). The strips of wire cloth can be rolled around the spools. Turn in the raw side edges of the wire strips so the wire cylinders will hold their shape. The sticks running through spools *J* (Fig. 255) are *crosstrees* from which the wire-

less-telegraph aerial (*U*) is suspended. Peg spool *I* of the foremast to block *E* with dowel-pin *F*, and peg spool *I* of the aftermost mast to the deck where the dowel-pin hole is located in Figs. 254 and 255 with another dowel-pin (*F*).

Make the spreaders of

The Wireless Aerial (Fig. 255) out of slender sticks, and use black thread for the wire strands (U).

Fighting-Tops *K* are fastened to mast spools *J* by means of dowel-pins *L*, which are driven into the spool holes.

The Turret Bases and Turrets. Holes must be bored through the center of turret blocks *N*, turret base blocks *M*, and into the decks (Figs. 251, 253 and 255), for dowel-pin pivots *P* to run through. These holes are located in Figs. 252 and 254. Make the pivots out of $\frac{1}{4}$ -inch dowel-sticks, or whittle sticks to this diameter. Glue the lower ends of the pivots in the holes bored in the decks, whittle the upper ends to fit the holes in button-moulds measuring $1\frac{1}{4}$ inches in diameter (*Q*, Fig. 255), and glue the button-moulds to the pivot ends after the turret base blocks and turret blocks have been slipped over the pivots. Holes must be bored in the side of the turret blocks for the guns to run into. To lessen the danger of splitting the blocks while boring, it is best to bore the holes before sawing the blocks from the stick from which they are cut. Figure 257 shows the location of the holes.

The Main Battery Guns (*O*, Fig. 255), mounted in the turrets, are shown in detail in Fig. 259. Take a $\frac{1}{4}$ -inch dowel-stick, or a stick whittled to this diameter, and cut from it eight pieces of the length shown (Fig. 261), then with a small wood-bit or drill, start a hole for the bore in the muzzle end of the guns, and with a jack-knife carefully taper the guns from end to end, as shown in Fig. 259. Smooth up the guns with sandpaper. Glue them in the holes in the turret blocks.

The Secondary-Battery Guns are mounted in the round blocks *R* (Fig. 255). Cut fourteen of the blocks from a $\frac{3}{8}$ -inch dowel-stick (Fig. 262). With a small bit or drill make a pivot hole through the center of the ends of each block, and another hole in the side of the block to run the gun into. Prepare the guns of the shape shown in Fig. 260. Cut them from a dowel-stick $\frac{1}{8}$ inch in diameter (Fig. 263). Start a hole in the muzzle end of each gun for the bore.

The Flagstaffs (*V*, Fig. 255)

FIG. 261 — Detail Showing How to Cut the Main-Battery Guns from a $\frac{1}{4}$ -inch Dowel-Stick

FIG. 262. — Detail Showing How to Cut Secondary-Battery Gun Mounts from a $\frac{3}{8}$ -inch Dowel-Stick

FIG. 263. — Detail Showing How to Cut Secondary-Battery Guns from a $\frac{1}{8}$ -inch Dowel-stick

for the lower deck. Drive $\frac{3}{4}$ -inch brads into the decks close to the sides (*W*, Fig. 264), bend the wire strips around the brads, and with wire bind them to the brads.

By fastening Keel Strips *X*

(Figs. 265 and 266) to the bottom of the hull, and mounting wheels upon axles run through screw-eyes screwed into the keel strips (Fig. 266), for

A Running-Gear, your toy battleship will

both float upon water and run upon land. Cut off the ends of a pair of spools for wheels (*Y*, Fig. 267), and fit $\frac{1}{4}$ -inch dowel-sticks into them for axles (*Z*).

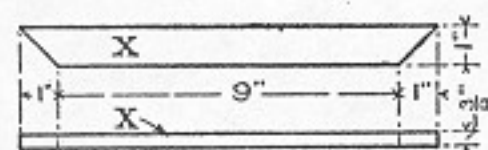


FIG. 265. — Side-Elevation and Plan of Keel Strips

assembling. It will be easier, and the parts can be allowed to become thoroughly dry before they are assembled, which will prevent the sticking of such pivoted parts as the gun-turrets and rapid-fire gun mounts. Surfaces marred while

Assembling can be touched up afterwards. There is not much work to putting the model together, when all parts have been properly fitted. In mounting the secondary-

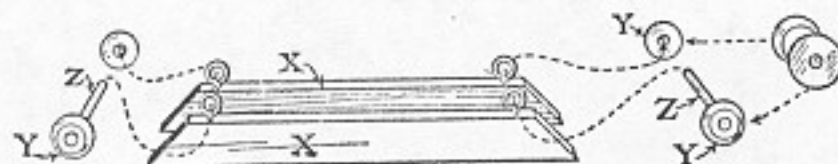


FIG. 266. — Details of Keel Strips and Running-Gear
FIG. 267. — Detail of Spool Wheels

battery guns, slip the fourteen gun mounts into the holes bored in the deck piece, then nail the deck piece to the hull, and drive brad pivots down through the deck and gun

are 3 inches long. Drill holes for them at the bow and stern of the decks.

The Deck-Rails are made of strips of wire cloth. Cut two strips $\frac{1}{2}$ inch wide, one for the superstructure deck, the other

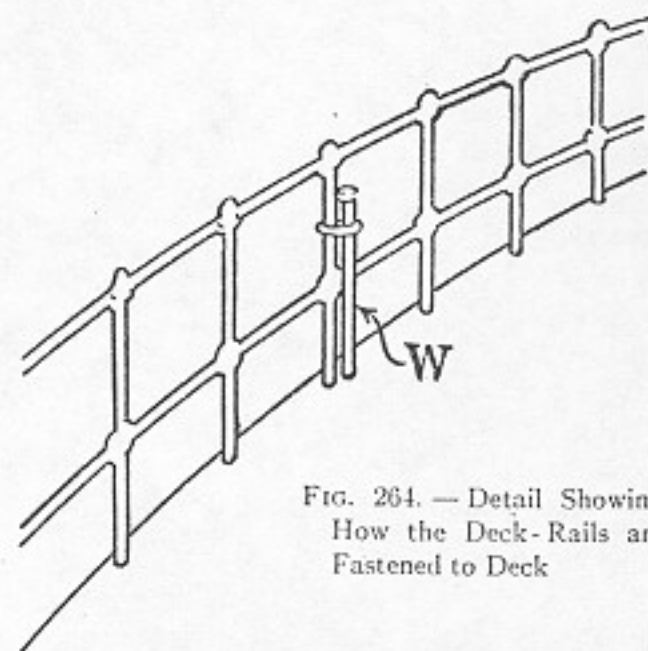


FIG. 264. — Detail Showing How the Deck-Rails are Fastened to Deck

Painting. With all work done as directed, the dread-nought will be ready for its coat of battleship-grey. The author suggests that you paint all parts before

you paint all parts before

assembling. It will be easier, and the parts can be allowed to become thoroughly dry before they are assembled, which

Assembling can be touched up afterwards. There is not much work to putting the model together, when all parts have been properly fitted. In mounting the secondary-

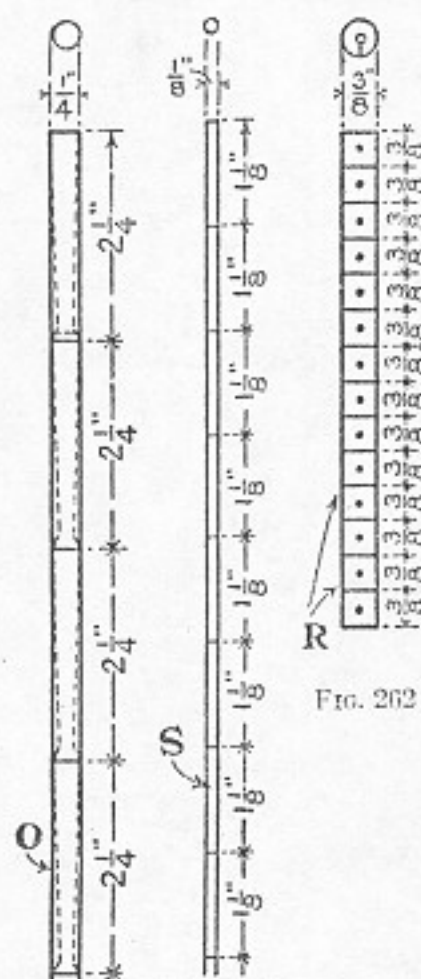


FIG. 261 FIG. 263

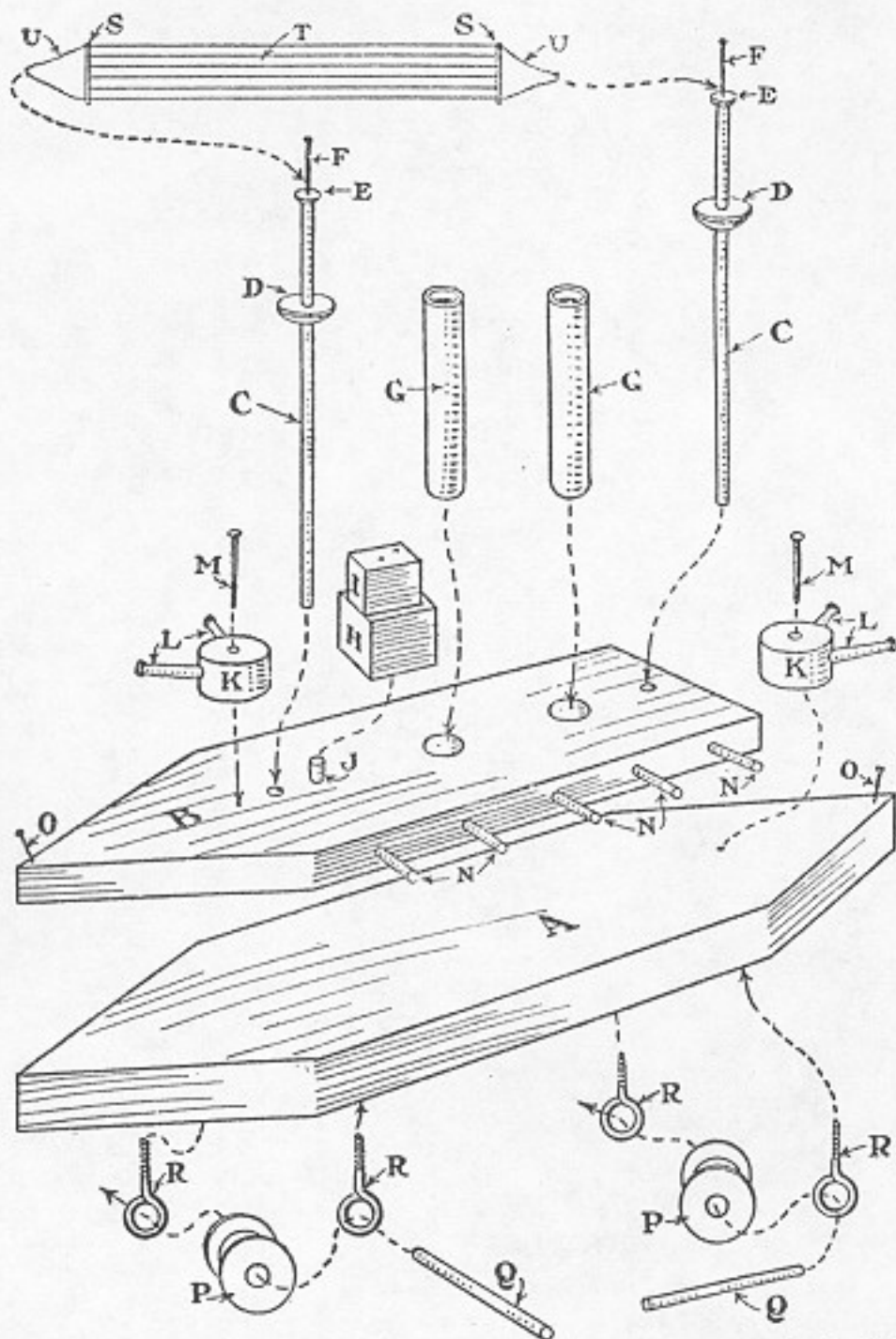


FIG. 282. — Detail Showing How the Hull (A), Superstructure-Deck (B), Masts (C), Fighting-Tops (D and E), Funnels (G), Conning-Tower (H, I), Gun Turrets (K), Main-Battery Guns (L), Secondary Battery Guns (N), Running Gear (P, Q, R), and Aerial (S, T, U) are Assembled

ships, forts, cannon, and paper and lead soldiers, you don't know what exciting fun you have missed.

In building the ships for a fleet, you probably will not want to make them all of the form shown in Fig. 251 of Chapter X. Several of that size will do. Make the others simpler, of the *cruiser* types shown in Figs. 281 and 293 of this chapter.

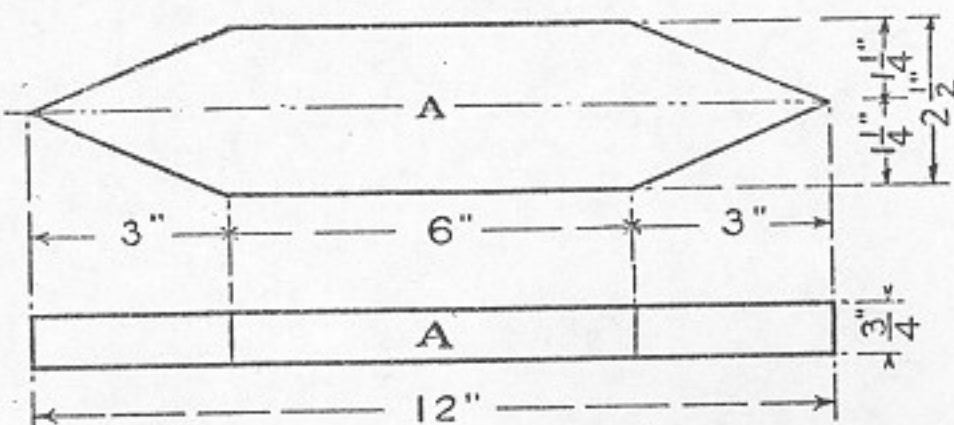


FIG. 283. — Plan and Side Elevation of Hull

Figure 282 shows a detail of every part required for

The Battleship shown in Fig. 281, with an indication as to how each part is assembled. Dimensions for the parts are given in the detail working-drawings of Figs. 283 to 292. If you build several ships alike, you will save time by making all of the parts for one ship, first, and then using these parts as patterns. Mark out and cut the *hulls* (A) for all the other boats, then the *decks* (B), then the *masts* (C), and so on. Use soft pine, cypress, or other soft wood, for the models.

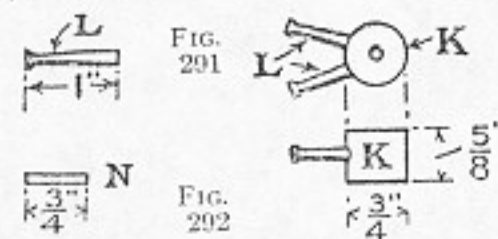


FIG. 290. — Turret and Guns
FIGS. 291 and 292. — Guns

Spool Wheels (P, Fig. 282), cut the stick axles Q to fit snugly in the spool holes, and support the axle ends with screw-eyes R, screwing these into the hull.

The Wireless Aerial is suspended between the mast-tops (Fig. 282). Use toothpicks for spreaders S and thread for wire strands T and end loops U.

The Cruiser shown in Fig. 293 is propelled by a paddle-wheel operated by a twisted rubber-band. The rubber-band untwists rapidly, so that the boat does not travel far before a re-twisting is necessary, but boys who have made this model have been satisfied with the results, so the author

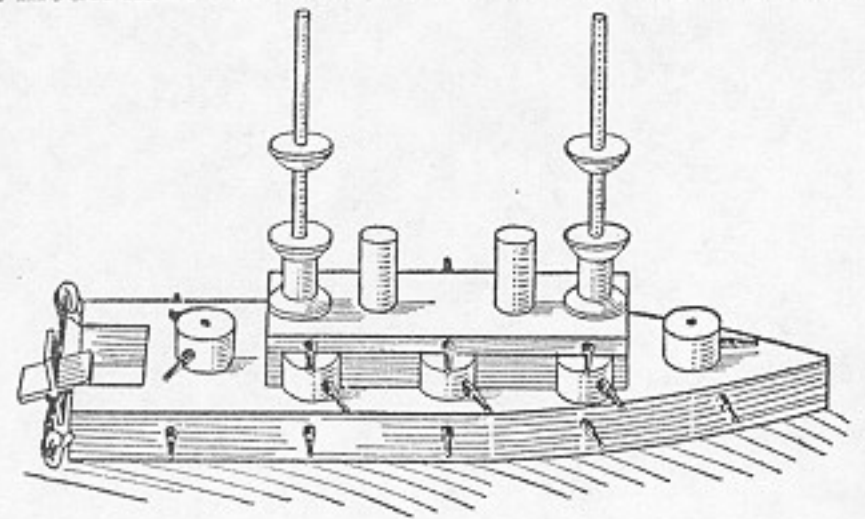


FIG. 293. — Toy Battleship with Propeller

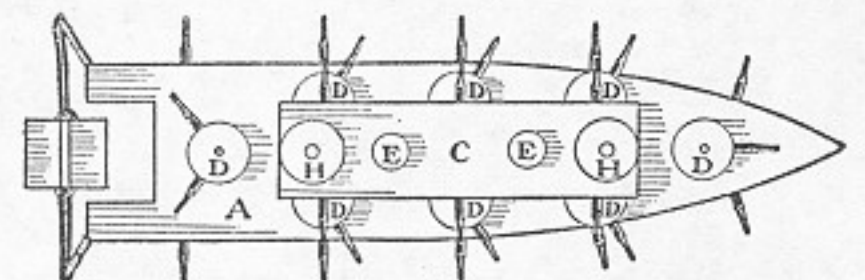


FIG. 294. — Plan of Completed Toy Battleship



FIG. 295. — Plan of Hull

believes that you will be satisfied, also.

Figure 294 shows a plan of the completed ship. The method of construction is quite similar to that of the battleship just described, so read over the instructions for making that model before beginning work on this one.

The Hull (A) is shown in plan in Fig. 295. After marking this out and cutting it, in the same way as described for the other model, prepare the blocks which form

The Superstructure-Deck (B and C, Figs. 296 and 297). Cut block B out of material $\frac{3}{8}$ -inch thick, by the width and length given. Bore the turret openings along the sides before cutting out the block, to prevent splitting it. Make these openings 1 inch in diameter. You will find the location of their centers shown upon the diagram. Holes E are for the funnel ends to fit in. Make them $\frac{5}{8}$ inch in diameter. Holes F are for the mast ends to fit in. Bore them in the positions indicated making them $\frac{1}{4}$ inch in diameter.

Cut block C of the same width and length as block B, out of material $\frac{1}{4}$ inch thick. Bore holes E and F through it in the same places as those bored through block B, so that when the two blocks are placed together, the holes will come over one another (Fig. 298).

The eight revolving

Gun Turrets (D, Fig. 294) can be sawed from a broom handle or portiere-pole. Figure 299 shows the size to cut them. The hole in the side is made to receive a gun. The turrets "fore and aft" have two holes each, for two guns. Another small hole must be drilled through the center of the ends of the turrets, as a provision for pivoting the turrets so that they will revolve.

Figure 298 shows the size to cut

The Main-Battery Guns. If you want to save work, do not taper the sides of the guns as shown. The tapering, however, adds much to their appearance.

The Secondary-Battery Guns. Set five of these in holes bored along each side of the hull, and three in holes in each side edge of deck piece C. (Fig. 293). You can cut these like the main battery guns.

The Funnels (E, Fig. 298) are shown in detail in Fig. 300. They drive down through the holes bored in blocks B and C of the deck.

The Masts (F) are $\frac{1}{4}$ inch in diameter and 6 inches long. Slip spools G upon them to come at the foot, and halfway between the

spools and the mast-tops fasten the spool ends H for

Fighting-Tops. You will find it easy to cut off the ends of a spool if you will slip a stick through the spool, to hold the spool by while sawing.

The first step in Assembling the model consists in nailing block B to hull A in the position indicated by dotted lines in Fig. 295. Then mount

the gun-turrets, six to turn in the openings in the sides of block B, the remaining two "fore and aft" $\frac{1}{4}$ inch from the ends of block B.

Having mounted the turrets, nail deck block C to block B.

The Paddle-Wheel (Fig. 301) is made of two pieces (I and J, Fig. 302), halved together—that is, each piece has a slot cut across half its depth, so that the two will interlock as shown in Fig. 301. Cut the pieces out of wood $\frac{1}{8}$ inch thick. Drive a double-pointed tack into the center of each

end of the assembled paddle-wheel, and connect a rubber-band to each tack. Then take a pair of screw-eyes, open each eye enough to form a hook (K, Fig. 303), screw the pair into the corners of the stern of the hull, at the angle shown

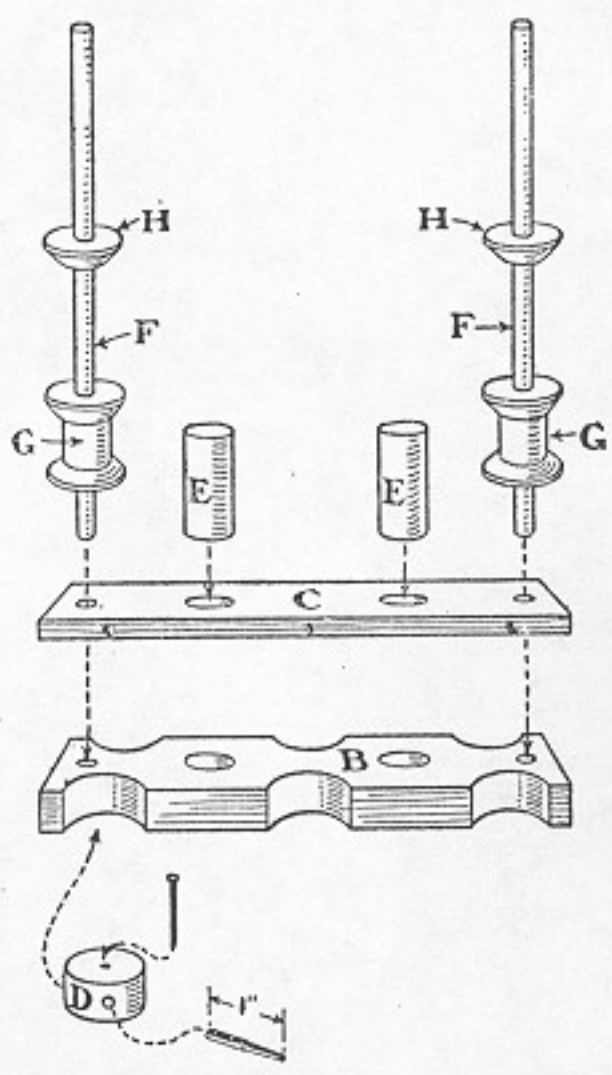


FIG. 298. — Detail Showing How Superstructure-Deck (B and C), Gun Turrets (D), Funnels (E), Masts (F), and Fighting-Tops (H) are Assembled

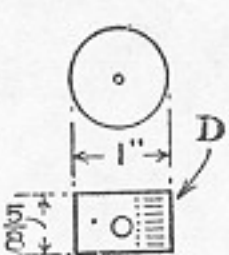


FIG. 299

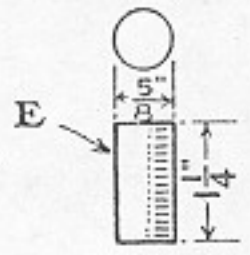


FIG. 300

FIG. 299 — Detail of Gun Turret
FIG. 300. — Detail of Funnel

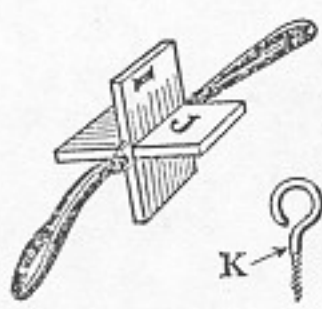


FIG. 301



FIG. 303

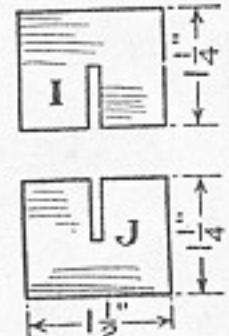


FIG. 302

FIGS. 301-303. — Details of Propeller

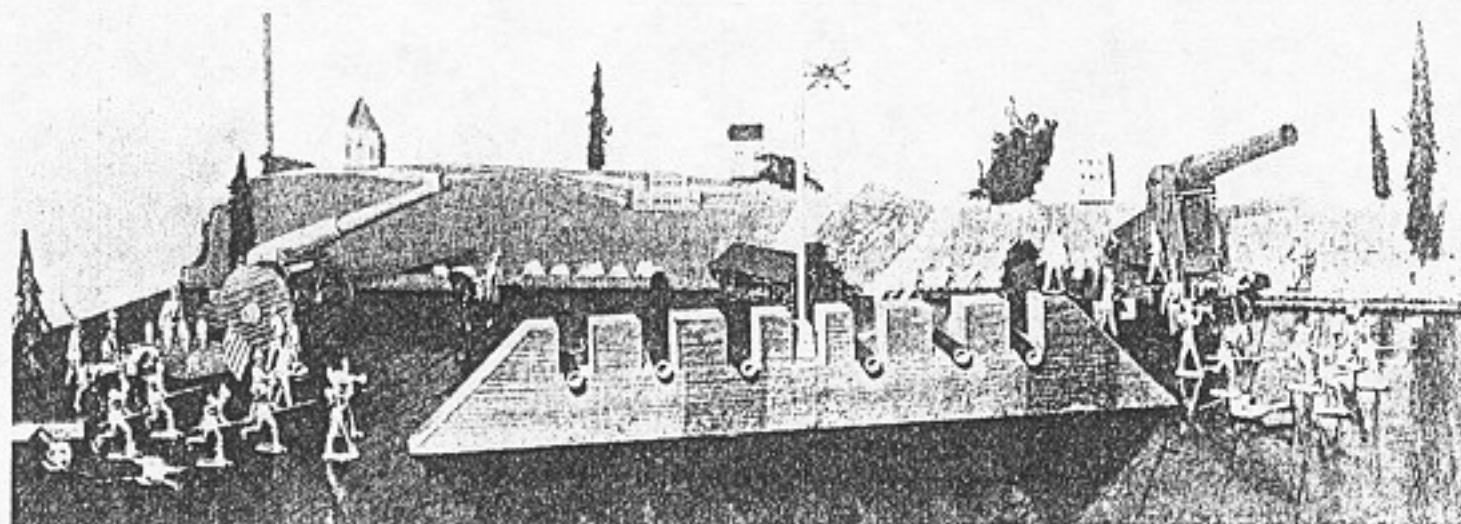


Fig. 304.—MINIATURE BATTLES CAN BE FOUGHT SCIENTIFICALLY.

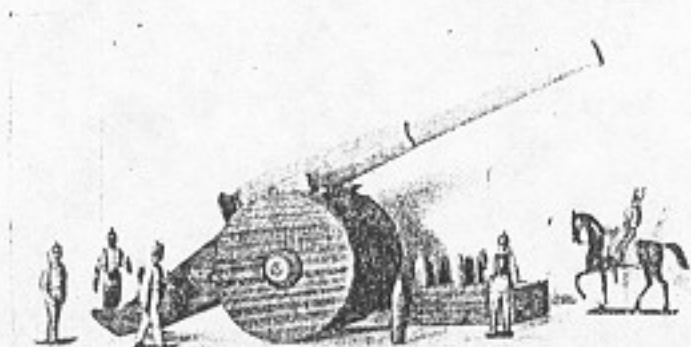


Fig. 305.—FIELD ARTILLERY GUN.

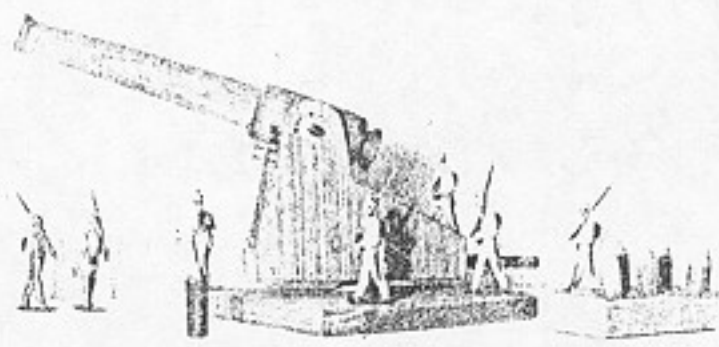
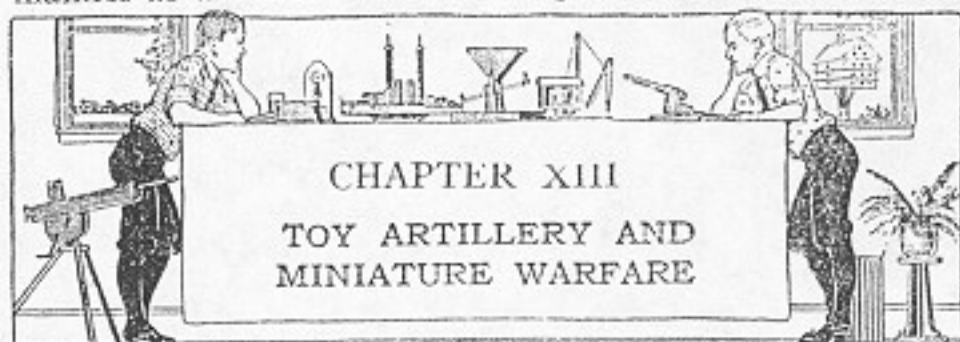


Fig. 306.—SIEGE ARTILLERY GUN.

in Figs. 293 and 294, and slip the ends of the rubber-bands over them. By setting the screw-eyes at the angle indicated, there is greater length of rubber-band to twist in winding the motor. This is important.

If you make this cruiser model for your indoor battleship fleet, you had better mount it upon wheels in the same manner as the model shown in Fig. 281 is mounted.



MINIATURE battles fought with toy soldiers and toy artillery can be made as scientific as those of real war, if one understands military tactics. Without that knowledge, however, you can make up your own rules of warfare, and the author believes that no more interesting game for an evening, or for a whole day, in fact, could be found. That more boys do not play with toy soldiers is probably because they haven't sufficient properties for staging a battle. A handful of soldiers and "dummy" cannon will not answer the purpose. There must be men and equipment enough for two opposing armies, and the guns must be of a type that shoot play shells, else they will afford little excitement.

When visiting several large toy shops recently, the author was impressed with the completeness of equipment for

miniature warfare, yet realized how impractical it was to expect that the average boy with limited pocket-money might buy enough of the equipment for a battle-field setting. Then he remembered as a lad how easily he had made guns, forts, etc., for miniature battles, and he decided to show you how you can do the same. Accordingly, when he went home he summoned his own lead soldiers, who had last seen service some twenty-five years ago, and to a man they responded (including three men decapitated by shell fire in one of the engagements of the early nineties). A "munition factory" was then organized, miniature fortifications built, and a battlefield prepared with men and artillery in battle formation, as pictured in the photograph of Fig. 304.

If you do not own any lead soldiers, you will find a good type of soldiers in the stores right now that sell at 50 cents a dozen. Paper soldiers can be purchased for 2 cents a dozen. Lead soldiers look best, of course, but paper soldiers serve excellently. The author never owned more than a small company of lead soldiers, and therefore depended upon paper soldiers for the main fighting strength of his armies.

Next to toy soldiers in importance are guns, and in Figs. 305 and 306 you will

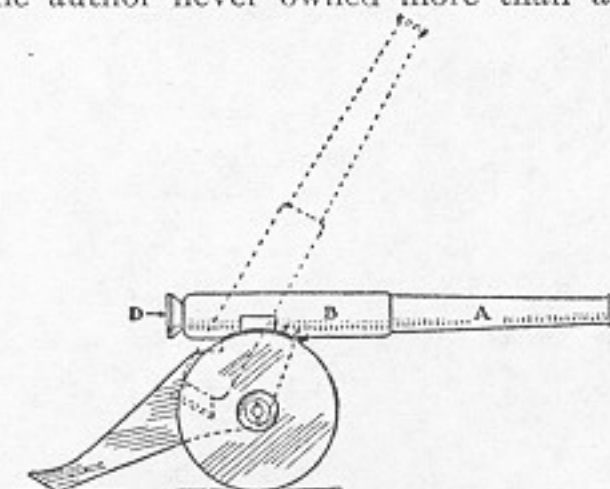


FIG. 307. — Detail of Field Artillery Gun

find two excellent models that are not hard to make. Shaping the guns is a simple problem in boring and whittling.

A working detail of

The Field Artillery Gun is shown in Fig. 307. The gun tube is made in two pieces, as is shown in the *longitudinal section* of Fig. 308 (A and B). Use straight-grained soft pine, free from knots and other defects for the tube pieces. First cut a pair of blocks to the dimensions of A and B (Figs. 309 and 310). Then with a $\frac{3}{8}$ -inch bit bore a hole

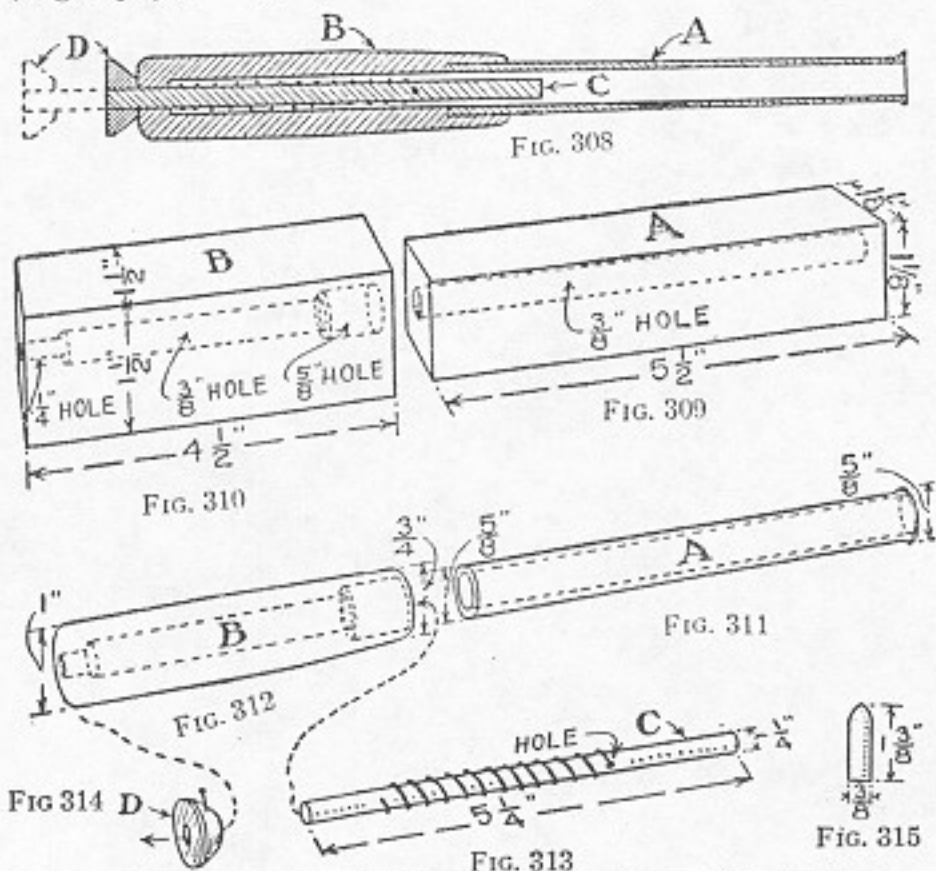


FIG. 308. — Longitudinal Section of Gun Shown in Fig. 307
FIGS. 309 and 310. — Wooden Blocks Required for Tube of Gun
FIGS. 311 and 312. — How the Blocks are Bored and Shaped
FIGS. 313 and 314. — Details of Plunger
FIG. 315. — Detail of $\frac{3}{8}$ -inch Shell

through the entire length of block A, at its center. A hole must be bored through block B from end to end, also, but three diameters must be used for this hole, as is indicated by dotted lines in Fig. 310. To make this hole, first bore

a hole $\frac{3}{4}$ inch deep with a $\frac{5}{8}$ -inch bit, then with a $\frac{3}{8}$ -inch bit and the same center, continue the hole for a distance of 3 inches, and from that point bore the hole through the remaining $\frac{3}{4}$ -inch length of the block with a $\frac{1}{4}$ -inch bit. In order to produce a bore that is straight, it is necessary to bore the holes exactly in a straight line.

With the blocks bored, put a keen edge upon your jack-knife blade, preparatory to

Shaping the Outside of the Gun. Figures 311 and 312 show the diameters to which the blocks should be cut. Shape down the small end of each block first, then work back to the other end. At the *muzzle* end of the block A, make the wood around the *bore* as thin as you can cut it without cutting through, and from that point taper the wood up to the other end. Round off the *breech* end of block B, and taper off the other end, as shown.

After cutting, sandpaper the surfaces of both pieces of the tube until absolutely smooth, and see that the end of piece A fits snugly into the hole in the end of B; these sections are to be glued together later.

The Plunger (C, Fig. 308) may be either a piece of a dowel-stick, or a stick whittled round, of the size shown in Fig. 313. Drill a small hole through the plunger stick $1\frac{1}{2}$ inches from one end, slip a piece of *spring-brass wire* through the hole, and wind the wire loosely around the stick to about the point shown, to form a spiral spring. Slip the end of the plunger into section B of the gun, and out through the hole in the breech. Saw off the end of a spool (D, Fig. 314), glue it upon the end of the plunger (Fig. 308), and drive a small brad through the spool end into the plunger end, to reinforce the connection.

Test the Gun to see that the spring rebounds properly after its compression, before you glue sections A and B together. Figure 315 shows a detail of the

Three-Eighths Inch Shells. These can be sawed up quickly, to the given length, if you will cut them from a

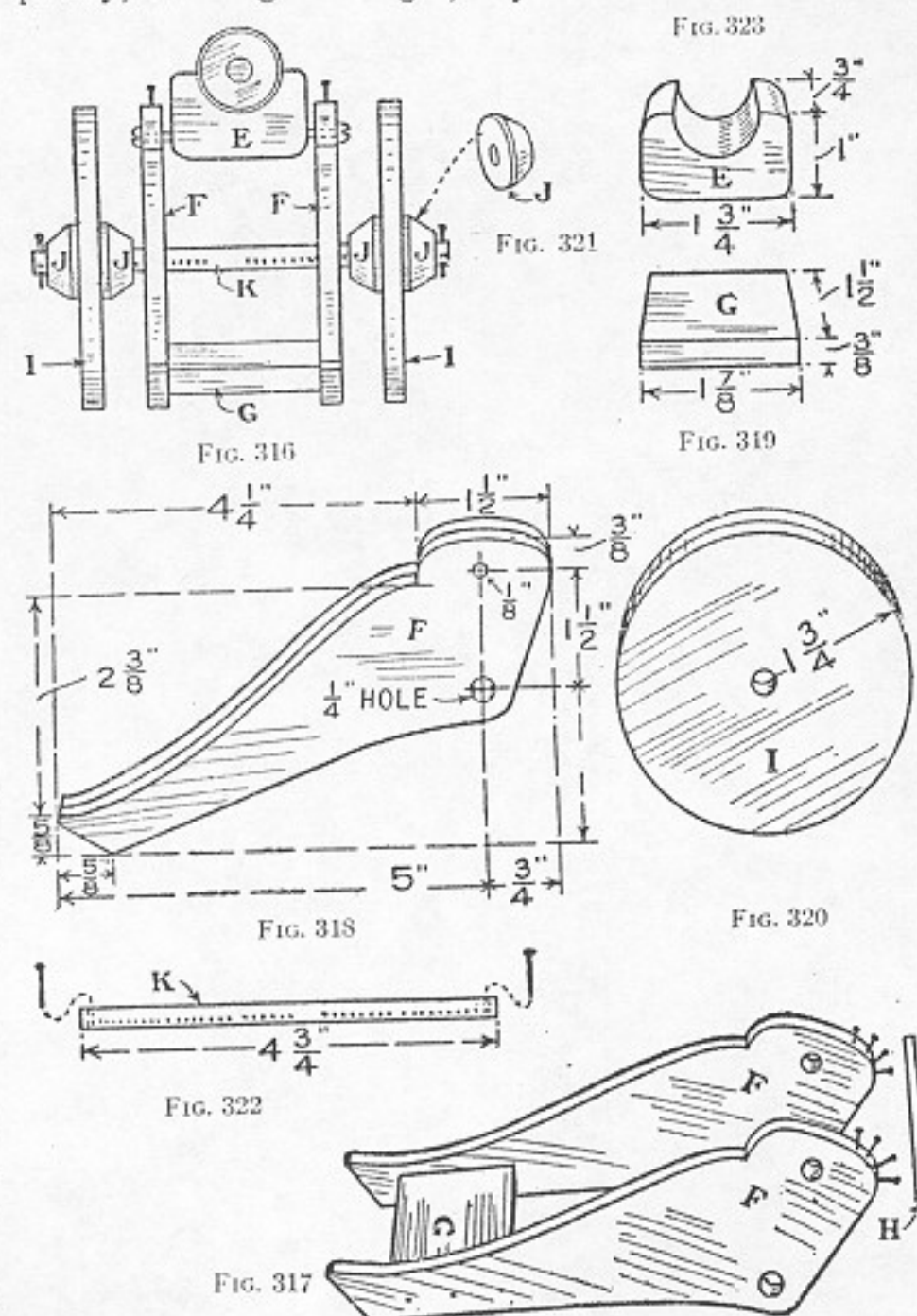


FIG. 316. — Rear Elevation of Mounted Gun
FIG. 317. — Detail of Gun Carriage
FIG. 318. — Pattern for Carriages
FIG. 319. — Carriage Separator Block
FIG. 320. — Wheels
FIG. 321. — Spool Wheel Hub
FIG. 322. — Wheel Axle
FIG. 323. — Bed Block for Gun

$\frac{3}{8}$ -inch dowel-stick. Taper one end of each shell to a point, as shown, and sandpaper smooth. To make the shells discharge from the gun with a minimum amount of friction, wax them and wax the bore of the gun.

If you find that the spring does not recoil satisfactorily, try a smaller or larger gauge of brass wire. Provided you use spring-brass wire, you should have no trouble with the coil. Space the turns of the coil about as shown in Fig. 313. With the spring properly adjusted, glue together the two sections of the gun tube, and the gun will be ready for mounting on

The Gun-Carriage. Figure 316 shows a *rear elevation* of the mounted gun, and Fig. 317 shows a detail of the *carriage* framework. The pair of carriages *F* may be prepared in one piece, cut out of a piece of wood $\frac{5}{8}$ inch thick, then sawed in half. Figure 318 shows a dimensioned pattern for marking out the piece. The $\frac{1}{4}$ -inch hole is for the wheel axle; the $\frac{1}{8}$ -inch hole is for the *trunnion* screws on which the gun is to be mounted. Separator block *G* (Fig. 317) braces the *trail* of the carriage. Make it of the size shown in Fig. 319. Before fastening carriages *F* to *G*, cut wheel axle *K* (Fig. 322), and slip it into the holes bored for it, to keep the holes opposite one another while you nail the pieces together.

The Gun-Carriage Wheels (*I*) may be prepared in one piece, then sawed in half. Figure 320 shows the pattern. The best way to cut a wheel is to saw out the pieces roughly, first, then trim up to the finish line with a sharp chisel, and sandpaper the edge smooth. The wheel hubs are spool ends (*J*, Fig. 321). Fasten them to the wheels with glue. Drive brads through the axle ends for pins to keep the wheels from coming off.

Mounting the Gun. Because of the thinness of the tube of the gun, the screw trunnions cannot be driven into it. The gun must be mounted upon a *bed block* (*E*, Figs. 316 and 323), and the trunnions screwed into the block's sides. The upper side of block *E* must be curved the same as the surface of the gun. To get the right curve, bore a 1-inch hole through a block, then cut this block through at the center of the hole, and trim it up to the dimensions shown in the diagram of Fig. 323. Glue the gun to the bed block, and when the glue has set drive a small screw through each carriage into it.

The Elevating Device of this home-made gun is simple. Drive four brads into the top edge of each carriage (Fig. 317), and cut the cross-bar *H* to slip between the brads. The bar can be adjusted to four positions.

The Siege Gun shown in Fig. 306 is made in much the same way as the field artillery gun just described. In the detail of the completed gun (Fig. 324), the dotted lines indicate two of the positions to which the gun can be elevated. The carriage is pivoted like a turntable to provide for shifting the position laterally.

Figure 325 shows a longitudinal section of the gun. The *tube* is made of two pieces (*A* and *B*), and Figs. 326 and 327 show the dimensions of the blocks out of which to cut them. Bore a $\frac{5}{8}$ -inch hole through the center of block

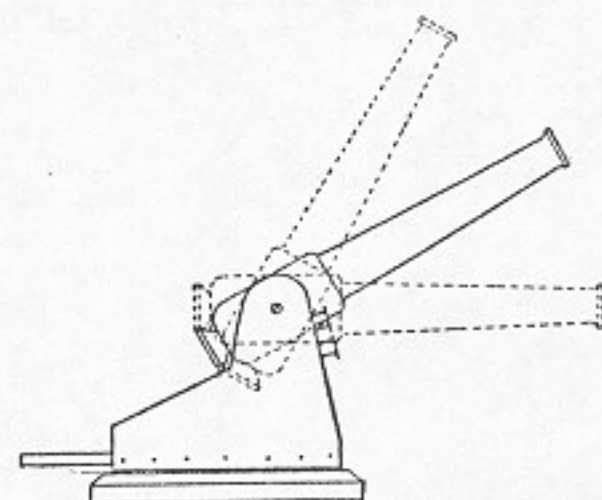


FIG. 324. — Detail of Siege Artillery Gun

A, from end to end, and a hole of the same size through all but $\frac{1}{4}$ inch of the length of block *B*; then with a $\frac{1}{4}$ -inch bit bore a hole through the remaining $\frac{1}{4}$ -inch of the length of block *B* (Fig. 327). Care must be taken to bore the holes absolutely straight, else the bore of the gun will not be straight, and the toy shells will lose momentum before leaving the muzzle of the gun.

The first step in

Shaping the Gun is similar to that of shaping the field artillery gun. Whittle off the edges of blocks *A* and *B* as shown in Figs. 328 and 329. The sides of block *B* must be kept straight; the sides of block *A* must taper to a smaller diameter at the muzzle end. Figures 330 and 331 give the diameters for the finished ends. In trimming up block *A*, cut the flange at the muzzle end to the same diameter as the opposite end (1-inch), then taper the wood from the opposite end towards the flange, making the thickness over the bore directly back of the flange, not much more than the thickness of paper. Round block *B* at both ends, as shown in Fig. 331. The pieces will then be ready for sandpapering.

Pieces *A* and *B* are connected by the tube *C*, a spool (Fig. 332) with its flanges cut off, and its sides whittled to fit snugly in the bores of *A* and *B* (Figs. 325 and 332). Before joining the gun-tube sections, however,

The Plunger for projecting the toy shells (*D*, Fig. 325) must be prepared, and be fastened in place in the breech end of the bore. Drill a hole through rod *D* $1\frac{1}{2}$ inches from one end, stick the end of a piece of *spring-brass wire* through the hole (Fig. 333), and wrap several turns of the wire about the rod to form a spiral spring (Fig. 334). With the spring prepared, stick the rod through the breech opening, and fasten a spool-end upon it with glue and a brad (*E*, Figs. 325 and 335).

When you have tried out the gun and found it to fire satisfactorily with

One-half Inch Shells (Fig. 336), cut out of dowel-sticks in the way that the shells for the other gun were made, glue together parts *A*, *B*, and *C*.

The Gun Carriage is shown in detail in Fig. 337. Cut carriages *A* in one piece, out of $\frac{5}{8}$ -inch stuff (Fig. 338),

then saw in half for the pair. Drill a hole where indicated, through which to run the *trunnions* on which the cannon is

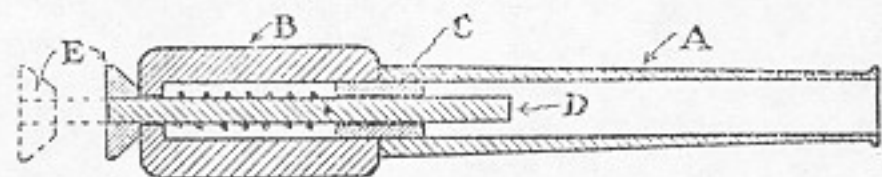


FIG. 325

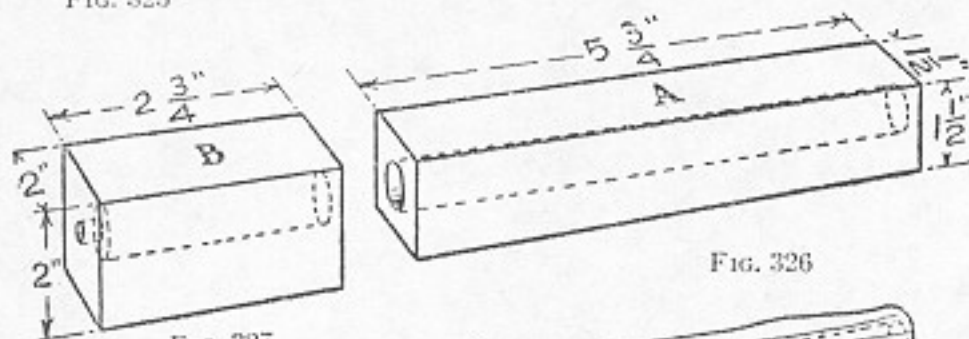


FIG. 326

FIG. 327

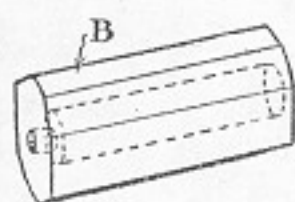


FIG. 329

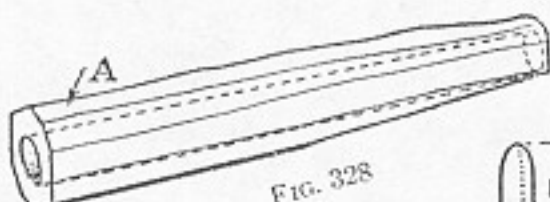


FIG. 328

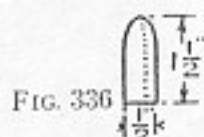


FIG. 336

FIG. 331

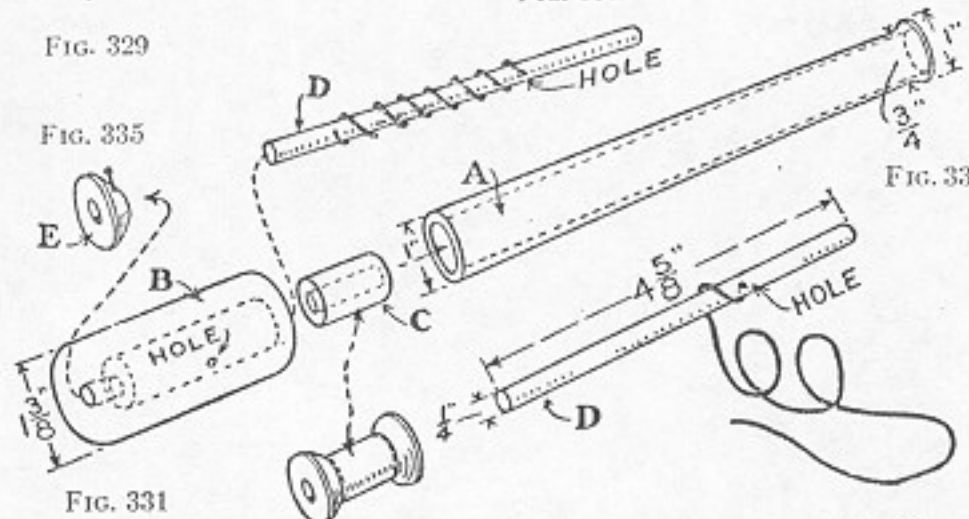


FIG. 335

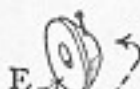


FIG. 331

FIG. 332

FIG. 333

FIG. 325. — Longitudinal Section of Gun Shown in Fig. 324
FIGS. 326 and 327. — Wooden Blocks Required for Tube of Gun
FIGS. 328 and 329. — How the Blocks are Bored and Shaped
FIGS. 330 and 331. — Tube Blocks Completed
FIG. 332. — Spool Connector
FIGS. 333-335. — Details of Plunger FIG. 336. — Half-inch Shell

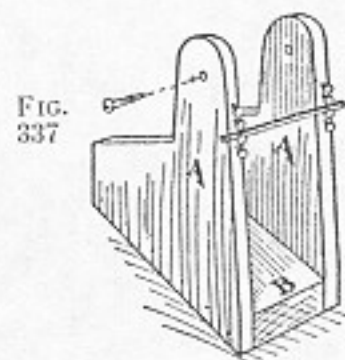


FIG. 337

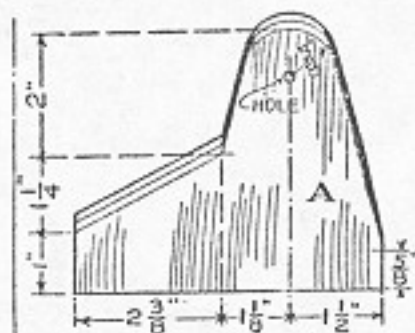


FIG. 338

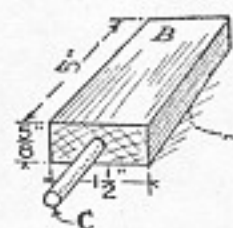


FIG. 339

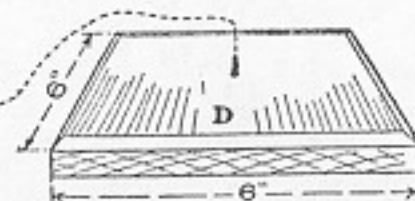


FIG. 340

FIG. 337. — Detail of Gun-Carriage
FIG. 338. — Pattern for Carriages

FIG. 339. — Carriage Base
FIG. 340. — Turntable Base

to be mounted. Cut base block *B* to the dimensions given in Fig. 339, nail the carriages to its sides, and drive *lever C* into a hole bored in one end. Cut *turntable* base *D* of the size shown in Fig. 340, bore a screw-hole through its center and drive a screw through the hole into base *B* of the gun carriage. The *trunnion* screws on which the gun is mounted, can be screwed through the holes in carriages *A* directly into tube *B* of the gun, because the thickness of the wood around the bore is $\frac{3}{8}$ inch. Do not drive the screws deeper than one-half of this thickness.

The Elevating Device is the same as that provided for the other gun (Fig. 337).

Painting, but a coat of black or grey paint will much improve their appearance. Do not attempt to paint the inside of the bores; in fact, be careful not to let any paint run into them, for this would gum them up, and possibly spoil the action of the plunger.

Figure 341 shows

A Fortification made out of a piece of 2 by 4. Figure 342 shows how to mark out the *embrasures*, or openings for guns.

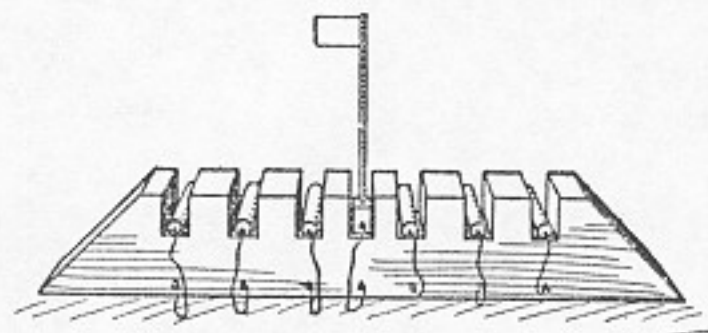


FIG. 341. — Fortification

Cut down the sides of the embrasures with a saw, and split out the wood between the saw *kerfs* with a chisel.

Pieces cut from a $\frac{1}{2}$ -inch dowel-stick, $2\frac{3}{4}$ inches long, with a hole started in one end of each (Fig. 343), will answer admirably for play

Disappearing Guns. Drive a tack into the breech end of each gun, and another into the fortification, beneath each embrasure, then connect the tacks with pieces of string (Fig. 341). The purpose of the strings is merely to keep the guns from becoming separated from the fort, and getting lost.

A Flagstaff is mounted in the center embrasure of the fortification, instead of a gun (Fig. 341). Stick a small flag in a block of wood, set the block in the embrasure, and connect a string to tacks driven into the block and into the fortification. As the flag is to be fired upon, don't use an American flag. That would be an act of disloyalty. You can make a small flag by fastening a piece of cardboard to the end of a stick, as shown in Fig. 344.

Suggestions for

Laying Out the Battlefield will be obtained from the photograph of Fig. 304. Books piled up along a wall of a room, and covered with a rug, will give elevation and

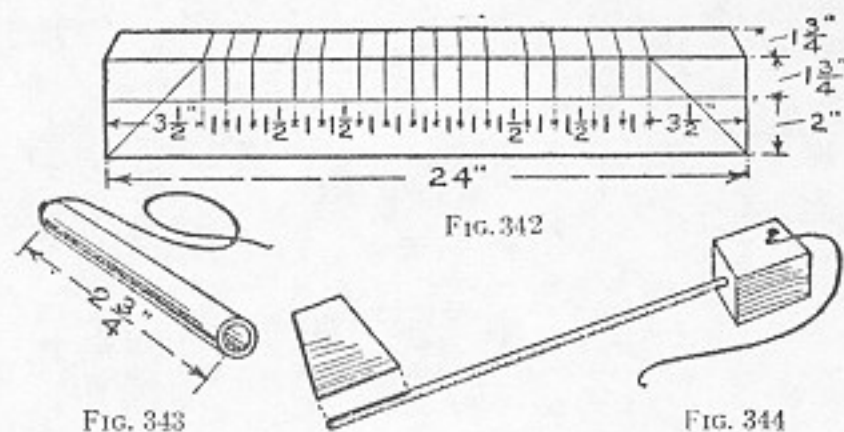


FIG. 342. — Pattern for Fortification
FIG. 343. — Detail of Gun FIG. 344. — Flagstaff

perspective to the background. Notice that the borders of the rug used in the battle scene shown in Fig. 304 make roads. Hang a sheet from tacks driven into the picture-moulding, for a sky background. Build small houses, churches, and other buildings out of cardboard. Use evergreen twigs for trees. Make tents out of small pieces of cardboard folded V-shape. The author wishes that he might show some of the other battle scenes he has modeled, with hills, valleys, streams, bridges, etc., but space does not permit it.

There are many ways of waging miniature wars. You can make and develop your own rules for fighting, and for determining the victors. Mr. H. G. Wells, the English author, literary critic, and war correspondent, wrote an interesting volume several years ago, entitled "Little Wars," which, if you can procure at your local public library, will give you many valuable suggestions for operating on both a large and a small scale. Mr. Wells has spent several days at a stretch, with friends, in working out miniature war maneuvers, and you will find his descriptions of battles won and lost, intensely interesting. The author's miniature battles, participated in by his brother, and his chum Captain David Ross Fraser, U. S. A., will always be remembered by each as among the most thrilling of their boyhood pastimes. Battles were fought out to a finish, until every gun on one side had been silenced, every man slain.



If you will carefully follow the instructions and working details given in this chapter, you will have in your possession after a few hours' work, the toy machine-gun shown in Fig. 408. This gun will fire twelve wooden cartridges in as short a time as it takes to turn the firing-crank twelve revolutions. It will wipe out an army of toy soldiers in no time at all. If you want to, you can organize a machine-

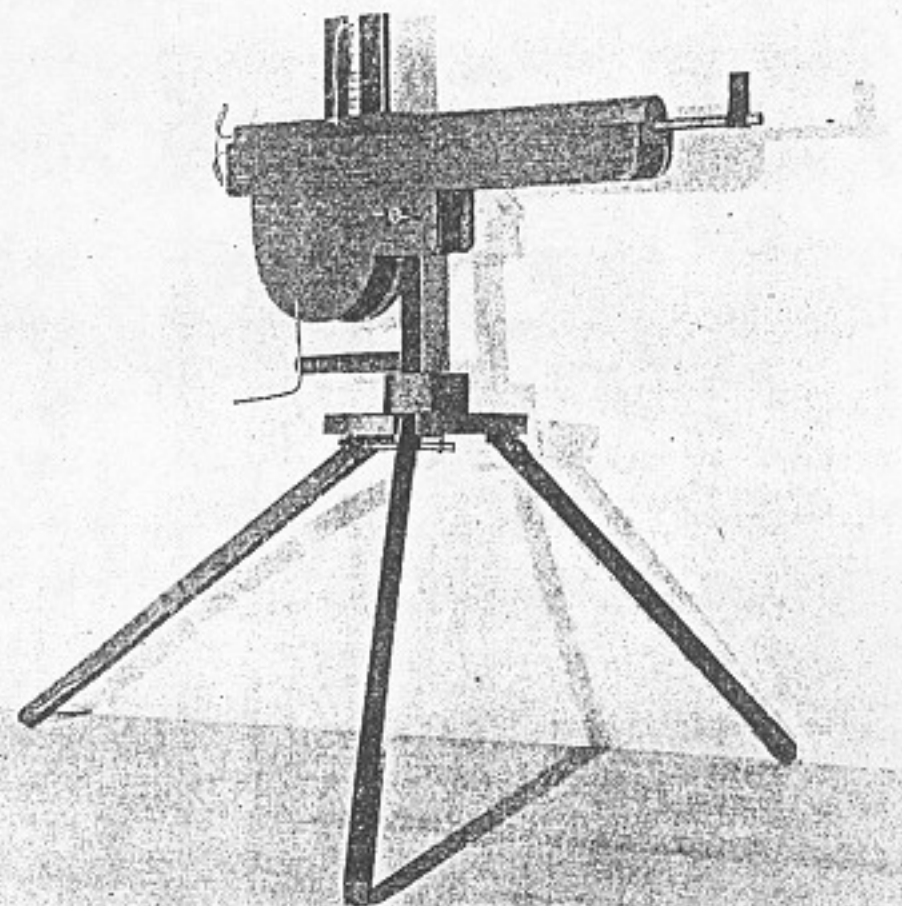


Fig. 408.—TOY MACHINE-GUN WITH MAGAZINE THAT HOLDS TWELVE WOODEN CARTRIDGES (See Chapter 17).

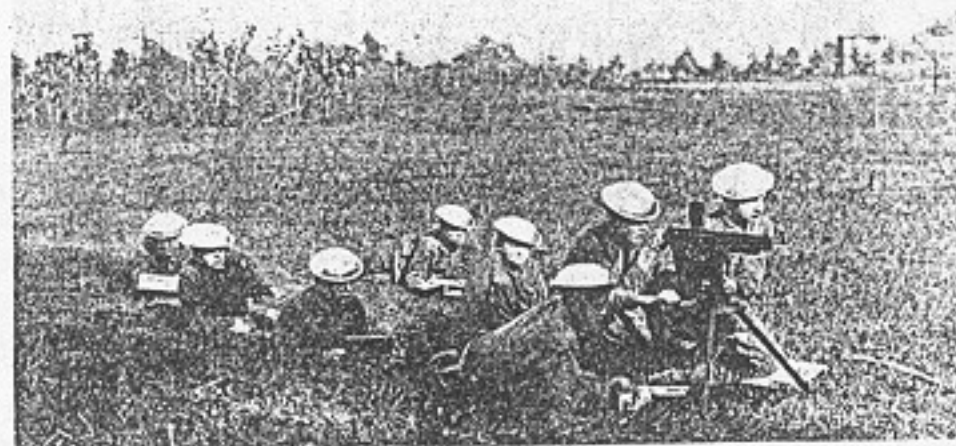


Fig. 409.—SQUAD WITH TOY MACHINE-GUN. THE HELMETS ARE MADE OF TIN WASH-BASINS.

gun squad and drill out in the open as the boys in the photograph of Fig. 409 are doing. A pamphlet on machine-gun drill can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Figure 410 shows a detail of the completed machine-gun, and the *tripod mount*. Figures 411 and 412 are longitudinal sections through the *stock*, *barrel*, and *cartridge chamber* and *magazine*, showing the *hammer* and *firing mechanism*. Figure 413 shows a longitudinal section of the gun-stock. This is the first part of the gun to prepare. It is made of three parts (*A*, *B*, and *C*). Figure 414 shows dimensions of the blocks required for parts *A* and *B*. After planing up these blocks square and true, and of the given dimensions, draw diagonal lines across both ends of block *A*, and across one end of block *B*, to locate the centers. Then with a $\frac{5}{8}$ -inch bit bore a hole through the center of block *A* from end to end, and another hole through the center of *B* for a distance of 7 inches. These holes are for the barrel (*F*, Figs. 411 and 417), a piece of brass-tubing $\frac{1}{2}$ inch in

the mortises carefully. Bore several $\frac{1}{2}$ -inch holes inside of the mortise lines, boring them as deep as the barrel bore, then cut out the wood between the holes with a chisel, and square up the mortises.

When blocks *A* and *B* have been prepared, fasten them together with plate *C* (Fig. 413). Cut this of the same width as the blocks, and 10 inches long, and lap it as shown. Handle *E* on the breech end is a wire coat-hook. Mark out side pieces *D* of the stock frame by the pattern shown in Fig. 416. The easiest way to prepare these parts so they will be alike is to tack together two $\frac{3}{8}$ -inch boards, mark out the outline upon one board, and then saw out the two pieces at one time. Plane up and sandpaper the edges, before separating the pieces. Also, bore the holes shown in Fig. 416—four $\frac{1}{8}$ -inch holes near the top edge, and four holes of the sizes marked, in the positions located. Use for these holes will be shown later.

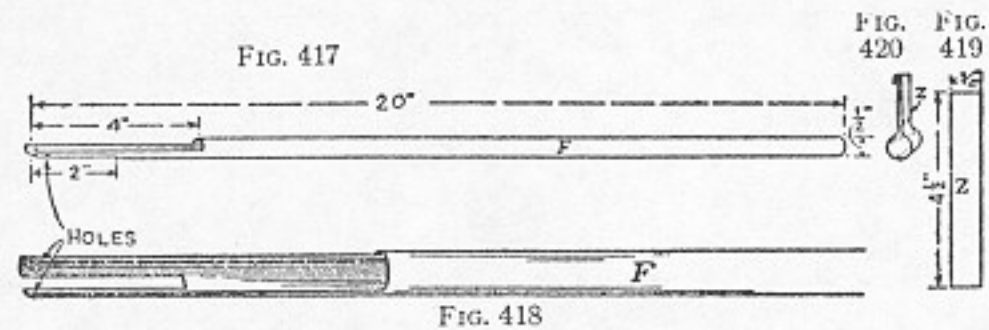
The piece of tubing for

The Barrel must be free from corrosion on the inside, it must be straight, and its ends must be reamed out with a file if burrs remain on the inside edges from the cutting of the pipe. The author used a piece of iron gas-pipe in his first model, but found that brass tubing is better as it presents a smoother inside surface, it is easier to cut, also. You can get brass tubing at almost any machine-shop. If they haven't a piece of the right size at hand, they will likely get a piece for you, or be able to tell you where you can get it. A piece 20 inches long is required. Figures 417 and 418 show how the chamber end of the barrel must be slotted for a length of 2 inches, and how the upper half of the tubing must be cut away for a distance of 4 inches. You can cut the slot with a flat file $\frac{1}{8}$ inch thick, using it edgewise, and making the slot equal in width to the thickness of the file. The upper part of the tubing can be cut away by using the file flatwise. The pair of small holes shown pierced through the tubing near its end are provided for anchoring the barrel in the gun-stock by driving a finishing-nail through the gun-stock and through the holes.

The Front Sight (*Z*, Fig. 410) is a strip of tin of the size shown in Fig. 419, bent to fit over the muzzle of the barrel, with the tip of one end of the strip hammered over on to the other end (Fig. 420).

The wire for

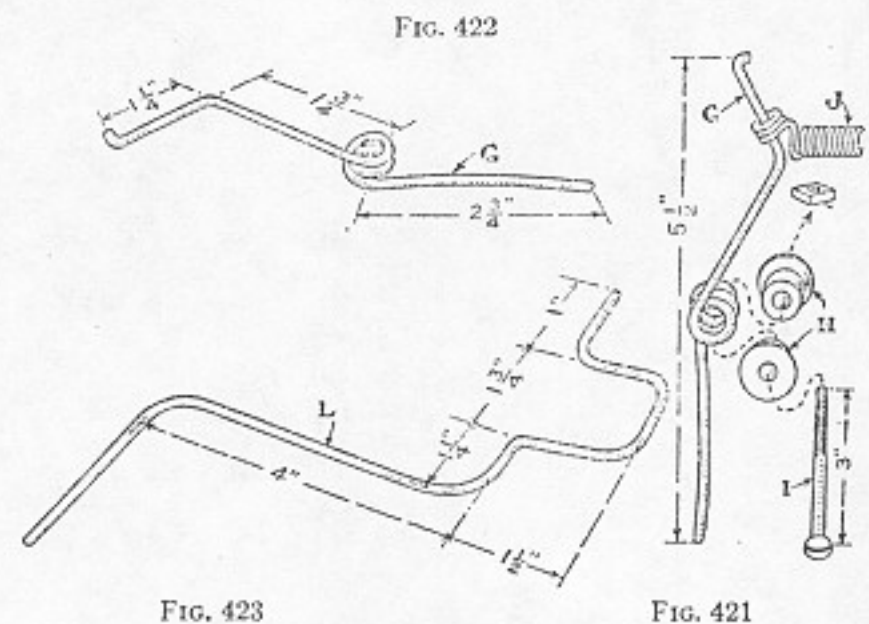
The Hammer Rod (*G*, Figs. 411 and 412) must be of No. 6 gauge. Figures 421 and 422 show the correct shape and size. To make the turns at the point for pivoting, bend the wire around a bolt or dowel-stick. Spools *H* (Fig. 421) are used to keep the rod centered half way between sides *D* of the gun-stock frame. Cut off as much of the end of each spool as is necessary to make the pair of the right length to fill the space each side of the rod. A $\frac{1}{4}$ -inch bolt 3 inches in length is required for the hammer-rod pivot (*I*, Fig. 421).



FIGS. 417 and 418. — Details of Tubing for Machine-Gun Barrel
FIGS. 419 and 420. — Details of Front Sight

The Hammer Spring is a screen-door spring (*J*, Figs. 411 and 421). Pull out several turns of one end as shown in Fig. 421, and slip them over the upper end of the hammer-rod. Pin the other end of the spring between pieces *D* with the nail *K* (Figs. 410 and 411), slipping the nail through the holes in the fore end of pieces *D*. It may be necessary to break off an inch or so of one end of the spring, to make it short enough so it will be held in tension when its ends are fastened.

The Firing Crank (*L*, Figs. 410 and 411) is made of wire of the same thickness as that used for the hammer-rod.



FIGS. 421 and 422. — Details of Hammer-Rod and Pivot
FIG. 423. — Detail of Firing-Crank

Figure 423 shows dimensions for bending the piece. The loop bent in this piece of wire acts as a tripper on the hammer-rod end, as you will see by looking at Figs. 410 and 411. The hammer-rod, spring, and firing-crank must be mounted in the gun-stock frame between side pieces *D* before the latter are fastened to the stock. Figure 411 shows the right position for the hammer tip when the hammer-rod has been released, and Fig. 412 shows the point to which the hammer must be drawn by the firing-crank rod tripper before being released. If you have bent the hammer-rod and firing-crank rod as shown in the drawings, the hammer tip should come at the two points shown. If it does not, bending the wires at slightly different angles will bring about the proper adjustment.

Before proceeding further with the construction, it will be well to test out the machine-gun with

Cartridges. These are pieces of dowel-sticks $\frac{3}{8}$ inch in diameter, cut to the length shown in Fig. 424, with one end whittled cartridge-shape. Sandpaper the cartridges smooth, then wax and polish them. To make the bore of the barrel as smooth as possible, pour oil into it, and then, with a piece of soft rag on the end of a slender stick, spread the oil and remove the surplus. Give plenty of time to testing the firing efficiency of the gun, and adjust and readjust the hammer-rod and firing-crank rod until you are satisfied with the results obtained.

The Magazine (Fig. 425) is fastened to the gun-stock directly over the upper mortise, so that the cartridges dropped into it will slip into the chamber beneath. Figure 426 shows how to cut the piece of tin required for the magazine, from the side of a tin can. Leave the turned-over edge on the can side, as shown, to reinforce the upper edge of the magazine. Figure 427 gives the dimensions for cutting and folding the piece of tin. Bend the lower

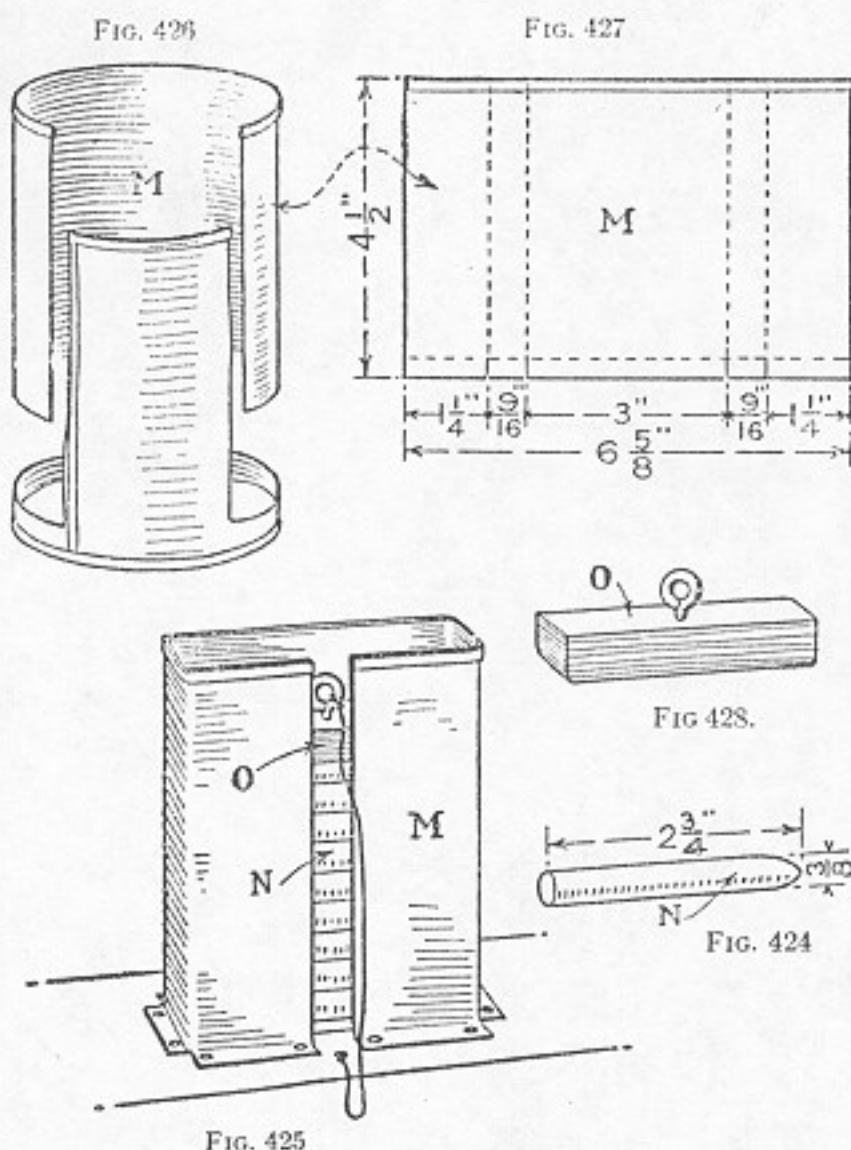


FIG. 424. — Detail of Cartridge

FIG. 425. — Magazine Filled with Cartridges

FIGS. 426 and 427. — Details of Magazine

FIG. 428. — Weight for Holding Cartridges in Position

edge to form flanges through which to drive tacks for fastening the magazine to the top of the gun-stock.

The weight shown in Fig. 428 is necessary to hold down the cartridges so the bottom cartridge will always be in

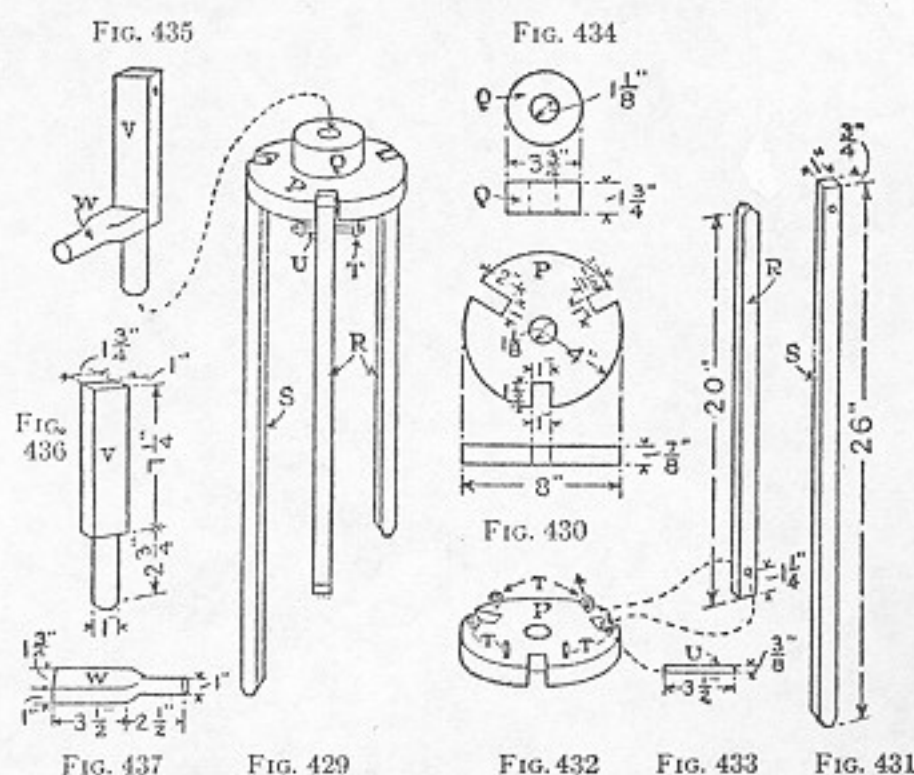


FIG. 429. — Machine-Gun Tripod

FIGS. 430-434. — Details of Tripod

FIGS. 435-437. — Details of Yoke for Mounting Gun on Tripod

the right position in the chamber for the hammer to strike. A piece of solder, or a piece of almost any kind of metal, will do. If you use solder, a screw-eye can be set into one side, to which to attach a piece of string as a means for lifting out the weight after the last of the cartridges has been fired, preparatory to refilling (Fig. 425). The slot in the side of the magazine is made wide enough so the finger can be slipped along it to guide the cartridges dropped into the magazine.

Figure 410 shows

The Tripod mount for the machine-gun, and Figs. 429 to 434 show details of its construction. Prepare the head block *P* of the dimensions given in Fig. 430, and cut three notches in the edge, of the sizes shown, and spaced equidistantly, for the legs. Bore the center hole to receive the yoke spindle *V* (Fig. 436). Cut the front pair of legs *R* and the rear leg *S* of the sizes shown in Fig. 431. Bore a $\frac{3}{8}$ -inch hole through each leg $1\frac{1}{4}$ inches from the upper end, and cut off the corners of the lower end as shown. To mount the legs, screw a screw-eye into the tripod head each side of each notch (*T*, Fig. 432), then cut the dowel-pin pivots *U* (Fig. 433), and drive them through screw-eyes *T* and through the holes in the legs (Fig. 429). Cut socket block *Q* of the size shown in Fig. 434, bore a hole through its center to receive the yoke *V*, and fasten it to the exact center of tripod head *P*.

Prepare yoke *V* and lever *W* (Fig. 435) of the dimensions shown in Figs. 436 and 437. Cut the spindle on the lower end of yoke *V* to fit the hole in socket block *Q*, and bore a hole through the upper end of the yoke through which to drive the axis bolt for pivoting the gun, to provide for

FIG. 441

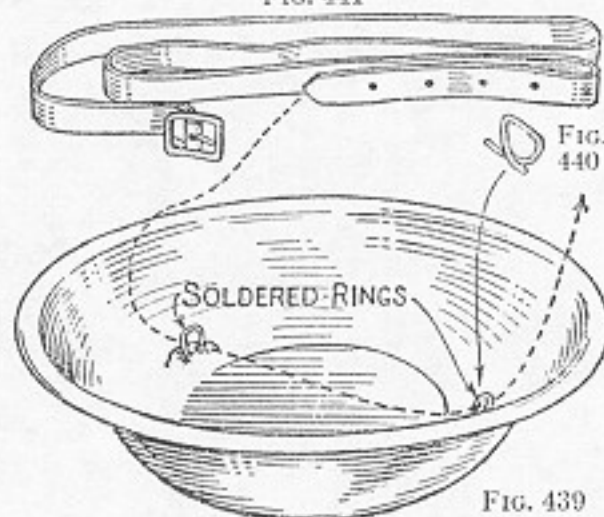


FIG. 439

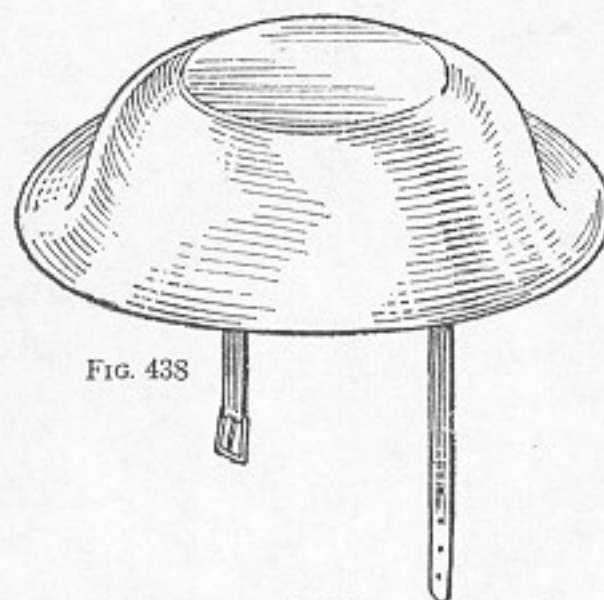
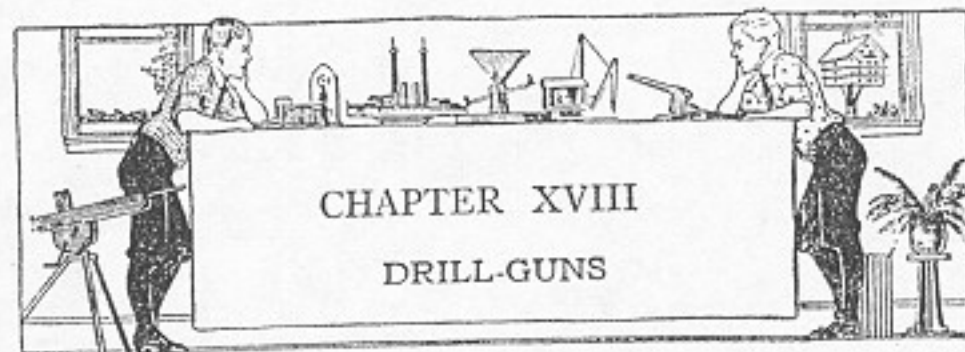


FIG. 438

FIG. 438. — Wash-Basin Helmet
FIGS. 439-441. — How to Attach Rings and Straps
to Wash-Basin

a tin wash-basin 11 inches in diameter (Fig. 439) with a pair of rings bent out of wire (Fig. 440) soldered to the inside, through which to run the chin-strap (Fig. 441). Stitch the strap to the rings, to keep the basin from slipping sidewise.



CHAPTER XVIII

DRILL-GUNS

EVERY boy wants to belong to a drill-club, and if instruction from a man with military training can be obtained, there is no reason why a boy's club or class should not organize a drill club. The handbook INFANTRY DRILL REGULATIONS, which can be purchased for 50 cents, should be obtained as a reference book, and should be followed closely. Its instructions will be understood more easily after drill movements have been demonstrated by the drill master.

changing elevations. Use the thumb-bolt X and wing-bolt Y (Fig. 410) for making this connection.

Paint all parts of the gun black or grey. To make them less conspicuous in the field, it is common practice to paint guns by what is known as the "rainbow smudge" system. But you will not want to dabble in the art of camouflage when finishing your toy machine gun.

To be an up-to-date machine gunner, you must wear a Helmet like that the boys in Fig. 409 are wearing. A detail of this helmet is shown in Fig. 438.

It consists of a

When the author was a lad, the neighborhood boys organized a drill-club; and commissioned him to make guns. These must have fallen far short of standard specifications, because there were no dimensioned drawings in the woodshed "arms plant" to work by; but, as the author recalls, the guns were fearsome looking weapons, with long tinfoil-covered stick bayonets, which, by the way, were "fixed" at all times — which is strictly against regulations, but unknown to the boys at that time. You can make better guns than these were, for this chapter presents all of the working details necessary.

The Simple Model of Drill-Gun shown in Fig. 444 has a stock cut in one piece. A pattern for this, ruled off into

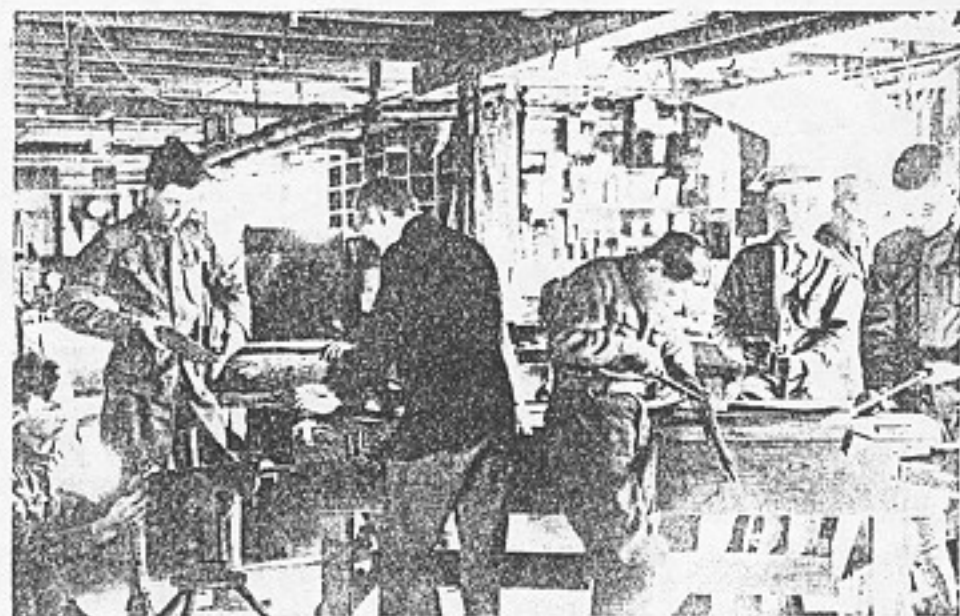


FIG. 442. — MAKING DRILL-GUNS.

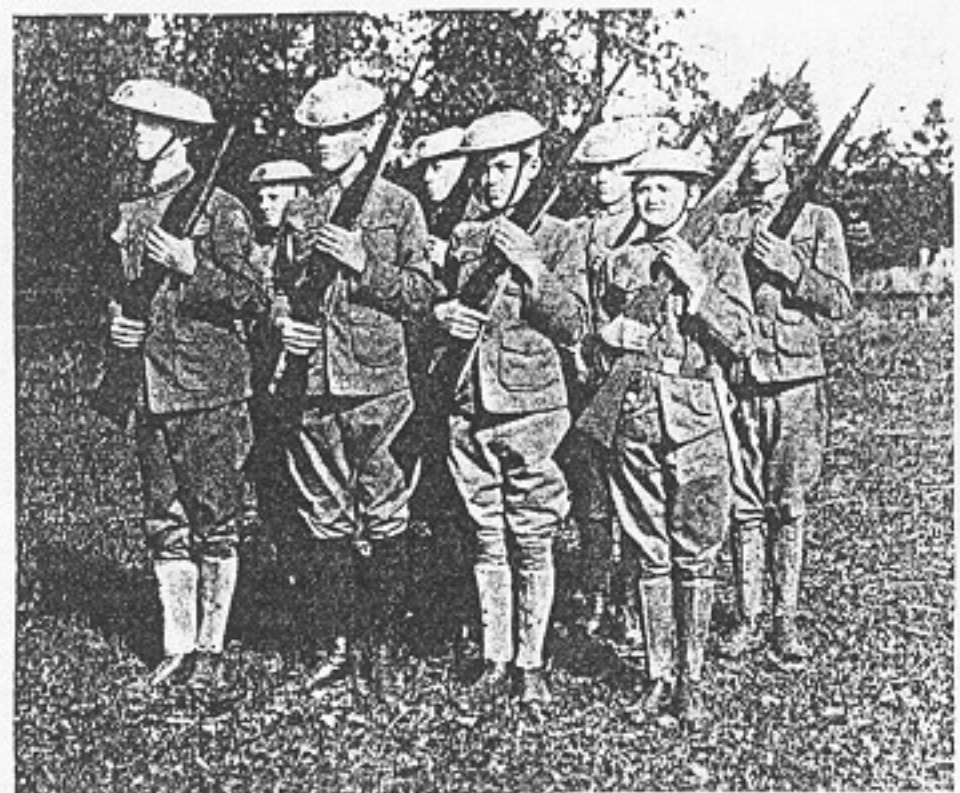


FIG. 443. — SQUAD AT "PORT ARMS" (EQUIPPED WITH HOME-MADE DRILL-GUNS AND WASH-BASIN HELMETS).

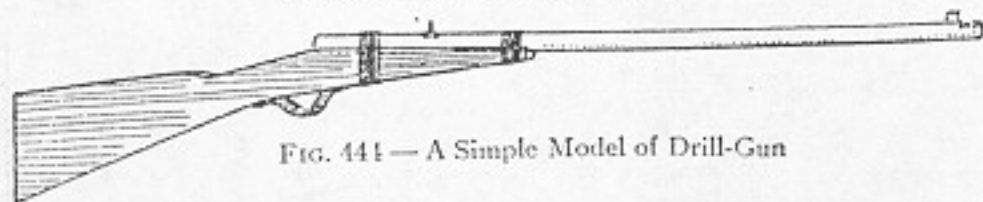


FIG. 444 — A Simple Model of Drill-Gun

squares measuring $\frac{1}{8}$ inch each way, each square representing 1 inch, is shown in Fig. 445. To lay out a full-size

pattern, draw a similar set of squares, 1 inch square, upon a piece of paper, and reproduce the outline exactly as it is shown upon the small squares. Saw out the piece, round the edges, and sandpaper the wood. This will provide

A Pattern for Marking Out Duplicate Stocks. You will save time by marking out at one time as many of the stocks as you will require.

The Barrel is made of a broom-handle (Fig. 447). Cut a shallow groove along the top edge of the stock for the barrel to fit in, and fasten the barrel with screws and wire bands.

For a Trigger, drive a bent nail (C, Fig. 448) into the stock at the point indicated in Fig. 446, and for

A Trigger-Guard fasten a plumber's pipe-strap (D, Fig. 448) to the stock, covering the trigger.

For the Front Sight, bend a piece of tin into the shape of E (Fig. 449), for

The Rear Sight (F, Fig. 450) cut a piece of tin of the shape shown in Fig. 451, bend it in half, turn up the ends, and bend down the tips of these. Tack the sights to the barrel in the positions shown in Fig. 444.

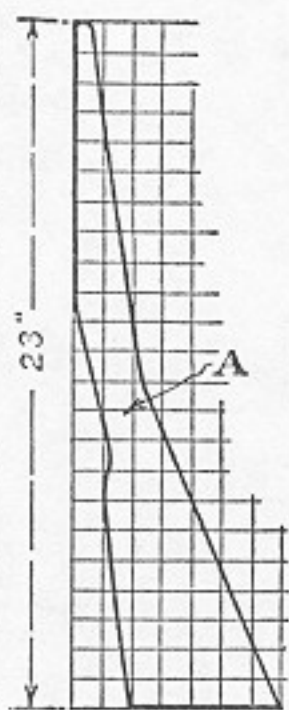


FIG. 445. — Pattern of Stock of Drill-Gun Shown in Fig. 444

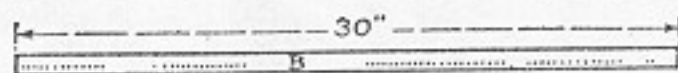


FIG. 447

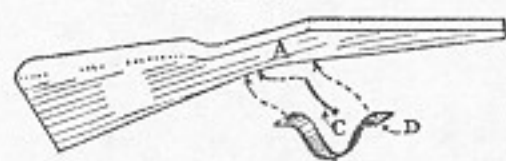


FIG. 446

FIG. 448

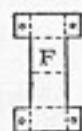


FIG. 449



FIG. 450



FIG. 451

FIG. 446. — Stock
FIG. 447. — Barrel

FIG. 448. — Trigger and Trigger-Guard

FIG. 449. — Front Sight
FIG. 450 and 451. — Rear Sight

The gun will now be ready for

Finishing. Give the stock a coat of stain or paint of a walnut color. Stain is preferable to paint. When the stain has dried, apply a coat of shellac, then a coat of flat varnish. Paint the barrel black; also the trigger, trigger-guard, and sights.

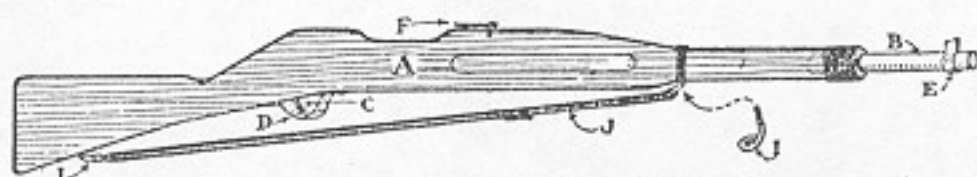


FIG. 452. — Springfield Model of Drill-Gun

The drill-gun shown in Fig. 452 is

A Springfield Rifle Model. Its stock requires considerable more work to cut than the stock of the simpler model, but most boys prefer it for drilling because its lines more nearly approach the lines of the modern army rifle.

Enlarge the pattern for

The Stock and Barrel, shown in Fig. 453, in the manner directed for the other model's stock. Be careful in enlarging this pattern to locate the various points correctly. Before cutting out the piece, it will be well to check up your measurements to be certain that you have made no errors. The barrel end may be either a piece of $\frac{1}{2}$ -inch dowel-stick, or $\frac{1}{4}$ -inch gas-pipe, 6 inches long (B, Fig. 454). Bore a hole 2 inches in depth in the barrel and drive the piece B into it. Fasten with nails if a dowel-stick is used, or with a screw driven through a drilled hole, if iron pipe is used.

The Trigger and Trigger-Guard (C and D) are the same as those of the other model of gun (Fig. 448).

The Front Sight (E) is shown in detail in Fig. 454. Figure 455 shows the shape and size to cut the strip required. A piece of a tin can will do. Trim off the ends of the strip as shown, bend the piece to fit around the barrel, and hammer the ends together.

The Rear Sight is made to fold flat against the top of the barrel (F, Figs. 452 and 456). When laid down, the position is known as *battle sight*; when raised, the semi-circular notch in the upper edge is known as the *open sight*, the hole beneath it is known as the *peep sight*. Cut a piece of tin of the size shown in Fig. 457, for leaf F, and turn the lower end over a piece of wire (G, Fig. 458). Bend the ends of the piece of wire into loops, and tack these loops to the sides of the gun-stock (Fig. 456). The leaf will turn up and down with the wire as an axis. Tack H (Fig. 456, driven close to the hinge of the leaf, will act as a stop when the leaf is raised, and can be used as the rear sight when the leaf

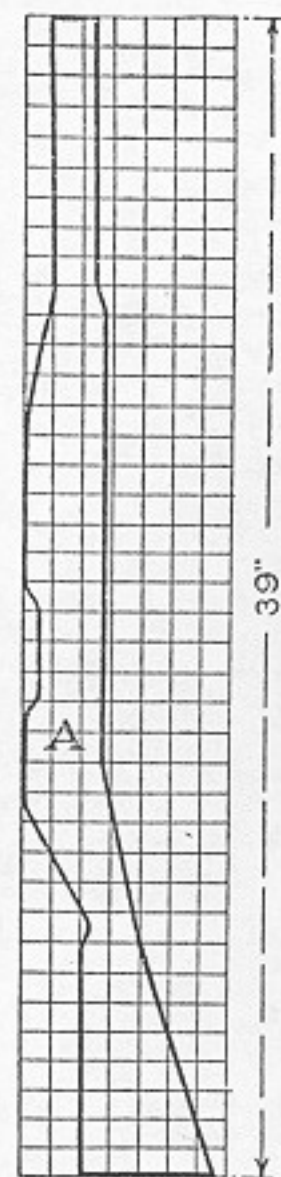


FIG. 453. — Pattern of Stock and Barrel of Drill Gun shown in Fig. 452

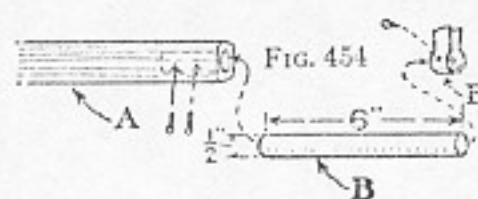


FIG. 454. — Detail of Front Sight
FIG. 455. — Pattern of Front Sight

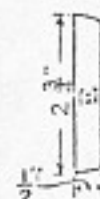


FIG. 457



FIG. 458



FIG. 456

FIGS. 456-458. — Details of Rear Sight Drop-Leaf



FIG. 460

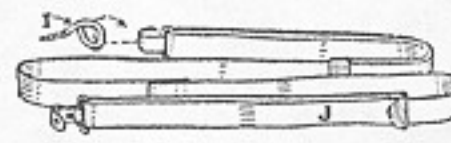


FIG. 459

FIGS. 459 and 460. — Details of Sling

is raised, and can be used as the rear sight when the leaf

is laid flat.

Finish the Drill-Gun in the manner suggested for the other model. Then it will be ready for

The Sling (J, Fig. 452), without which it would not be complete. An excellent sling that will resemble more or less closely a modern rifle sling, can be made of an old pair of suspenders. Figure 459 shows a sling so made. Separate the suspenders where crossed (Fig. 460), cut off the button-hole tips on the rear ends, and sew the two lengths together. The *snap*s on the front ends will then snap over the eyes I, screwed into the stock (Fig. 452), and the *slide-buckles* can be used to shorten the straps. For the eyes use bent-over screw-eyes (I, Fig. 452). Stain the sling with walnut stain, to make it look as nearly like leather as possible.

The Weight of a Springfield is 8.69 pounds. Your drill-gun, even if made of heavy wood, will be extremely light by comparison.

To Increase the Weight of Drill-Guns, the author has found it a good scheme to bore several holes in the stock and barrel, and pour these full of melted lead. In doing this, be careful to keep the center-of-balance at about the position of the rear-sight leaf.

A Bayonet is easily made out of wood (Fig. 461). Cut the *blade* of the shape and size of A (Fig. 463), and build up the *grip* end with the blocks B. Bend a piece of heavy wire into a double loop, like C (Fig. 465) for the *guard*, and cut a groove across the inner face of blocks B for the wire

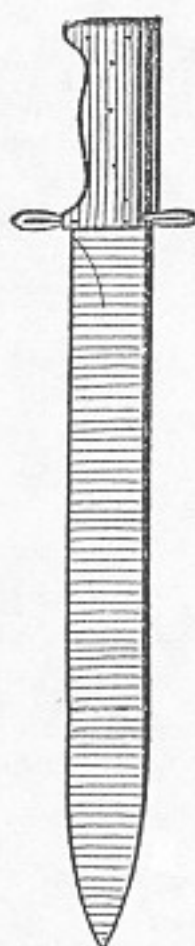


FIG. 461. — Bayonet

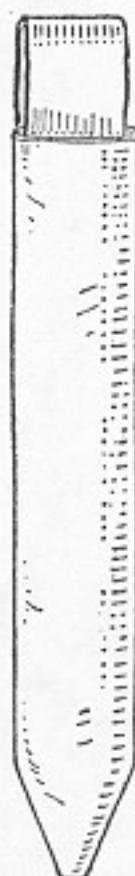


FIG. 462. — Scabbard

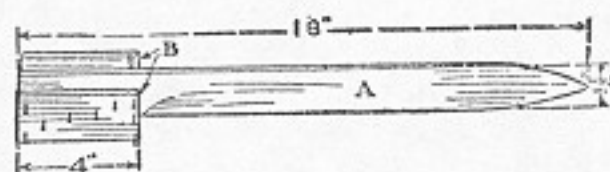


FIG. 463. — Detail of Bayonet

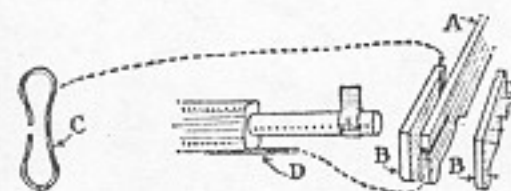


FIG. 465

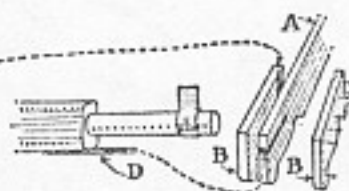


FIG. 466



FIG. 464

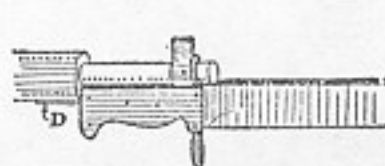


FIG. 467. — Gun with Fixed Bayonet

FIGS. 464-466.—How Grip of Bayonet Attaches to Gun

to fit into (Figs. 463 and 464). Cut a slot 2 inches long in the end of the blade (Fig. 464). Nail the grip blocks to the end of the blade, and then shape the assembled grip as shown in Fig. 467. If the loops of the guard have been bent properly, they will slip over the muzzle of the barrel. To hold the end of the grip, fasten the metal strip D (Fig. 466) to the stock, to fit in the slot cut in the end of the blade (Fig. 464).

Finish the bayonet by first sandpapering the wood very carefully, making the edge sharp and straight. Then paint the blade with aluminum paint, and finish the grip with walnut stain.

A Scabbard for the bayonet is shown in Fig. 462. Make this out of two pieces of cardboard, glued together along the edges, with a covering of khaki-colored cloth. Make the top loop large enough for your belt to run through.



EVERY boy ought to know how to converse by means of one of the several signal systems in common use. About the simplest system to learn, and one which makes rapid sending possible, is the two-arm semaphore system; therefore, the way to make a pair of hand signal flags, and the signal-code, is shown in this chapter.

It is not necessary to own a pair of flags to learn the code, since the positions of the arms of the boy signalling determine the code letters. The flags serve to amplify the hand positions, and of course this is necessary when sending from a distance. It is easiest to learn the code without the flags, because then you need concern yourself only with the positions of your arms in forming the letters. As soon as you have memorized the positions, and can send at a rate of at least thirty letters a minute, you will be so proud of your achievement that you will want to own a pair of flags at once.

A Hand Flag of Standard Size is shown in Fig. 468, its dimensions are given in Fig. 469, and the size of its staff is shown in Fig. 470. The flag is divided diagonally into two parts, one of which is made of red muslin, the other of white. Cut the cloth enough larger than shown to allow for turning over $\frac{1}{4}$ inch of each edge for a hem. If you have mother or sister do this stitching on the sewing-machine, it



TWO-ARM SEMAPHORE SIGNALING BY A PATROL OF THE AUTHOR'S TROOP OF
BOY SCOUTS OF AMERICA, ELMHURST, ILLS.

will be the best way of getting a good job done quickly. Cut the staff stick of the size shown, round the edges, and sandpaper all surfaces smooth. Then shellac it, and when the shellac has dried tack the flag to one side.

Memorizing the Code is not difficult, but it requires continuous practice to get to the point where one can send rapidly. The following suggestions will help you "get the hang" of it, and probably you will be able to work out schemes of

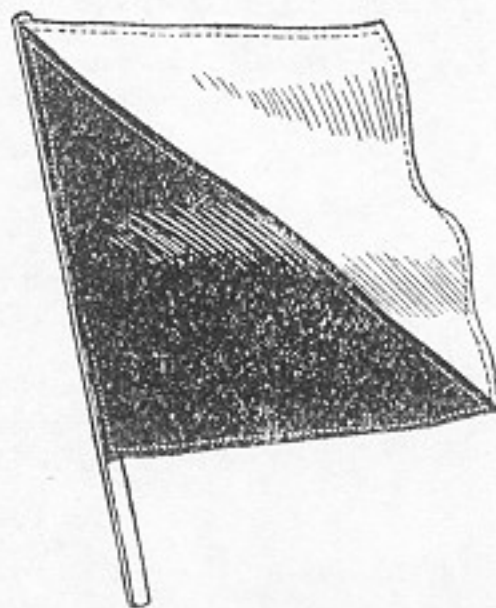


FIG. 468. — Hand Flag

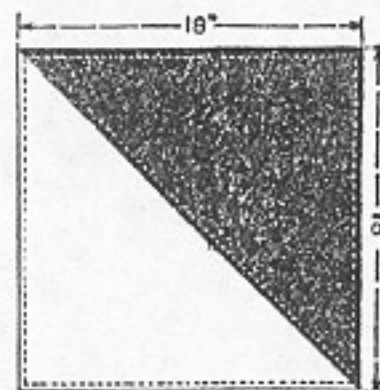


FIG. 469. — Pattern for Hand Flag

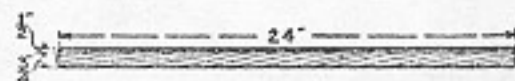


FIG. 470. — Staff for Hand Flag

your own that will help you remember the formation of certain letters.

Observe, first of all,

that the positions of the arms in forming the letters of the alphabet are eight in number, and correspond to the positions of the hour-hand of a clock when at 6 o'clock, 7:30, 9 o'clock, 10:30, 12 o'clock, 1:30, 3 o'clock, and 4:30. Observe, also, that the arms advance *clockwise*, in going through the alphabet.

In forming letters *A* to *D*, the left hand is placed in the position of a clock's hour-hand when at 6 *o'clock*, the right-hand is placed successively at 7:30, 9 *o'clock*, 10:30, and 12 *o'clock*. In forming letters *E* to *G*, the right hand is substituted for the left hand, and the left hand is advanced from 1:30 to 4:30. For letters *H* and *I*, the left hand is held at 7:30, the right hand is placed at 9 *o'clock*, then at 10:30. Letters *K* to *N* are formed with the right-hand

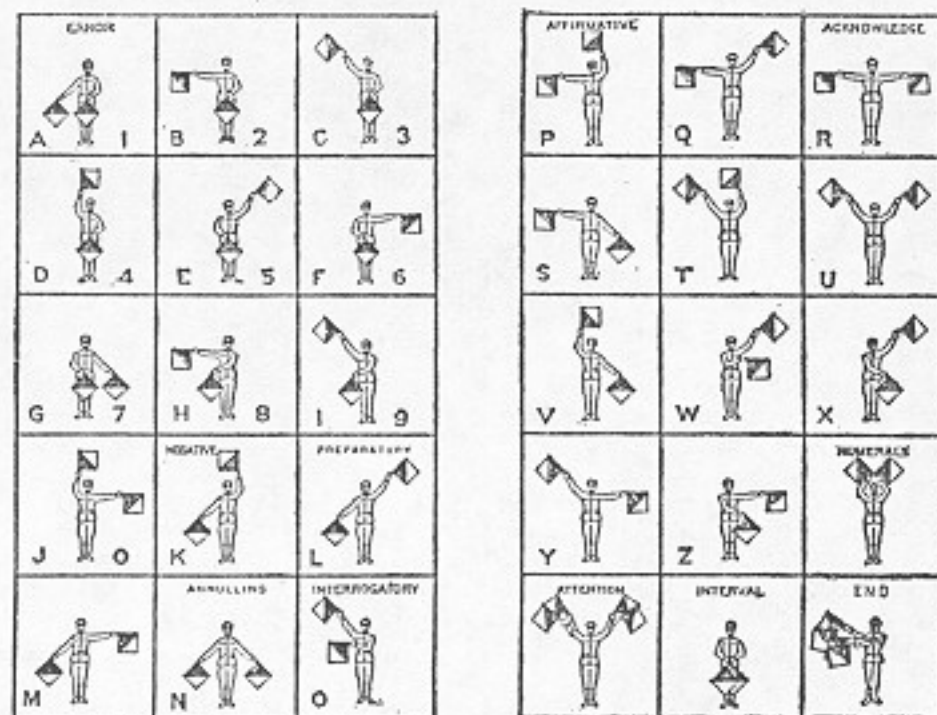


FIG. 471.—Signal Code

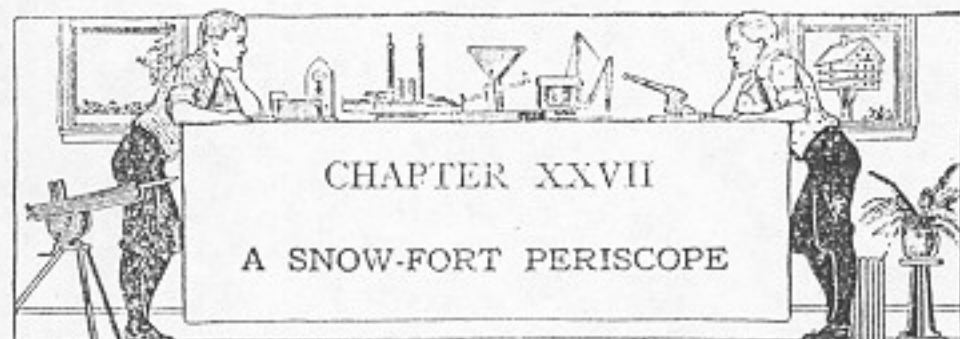
To Attract Attention, before starting to signal, shake the flags above your head in the positions indicated for *attention*. Before sending *numerals*, cross the flags over head as shown for *numerals*. Use letters *A* to *J* for *numbers*. Spell out *numerals* when they come in the body of a message. If you make an *error*, signal *A*. To *annul* a message, make *N*. To *acknowledge* that the message has been understood, make *R*. To signify *readiness*, send *L*. Indicate a *negative* reply by *K*, an *affirmative* reply by *P*, a *question* by *O*.

Finish a Message with a chop-chop motion of the flags at the right, as indicated for "end." Abbreviations will not be confused with letters, by the receiver, if the sender follows them with the *interval*.

held at 7:30, the left hand is placed successively at 12 o'clock, 1:30, 3 o'clock, and 4:30. For letters *P* to *S*, the right hand is held at 9 o'clock, the left hand is placed successively at 12 o'clock, 1:30, 3 o'clock, and 4:30.

For letters *T*, *U*, and *V*, the right-hand is held at 10:30, the left hand is placed at 12 o'clock, 1:30, and 3 o'clock. For letters *J* and *V*, the right hand is held at 12 o'clock, the left hand is placed at 3 o'clock and 4:30. For letters *W* and *X*, the left hand is held at 1:30, the right hand at 3 o'clock and 4:30. For letter *Z*, the left hand is held at 3 o'clock, the right hand at 4:30.

Remember that the letter *U* is like a letter *U*, that letter *N* is *U* inverted (same as small letter *n* is letter *u* inverted); letter *Y* is like a letter *Y* except that the left-hand is dropped one position; letter *X* is really the left-hand side of a letter *X*. Opposite letters are *A* and *G*, *B* and *F*, *C* and *E*, *H* and *Z*, *I* and *X*, *J* and *P*, *K* and *V*, *O* and *W* (think of *O* and "double-yo"), *M* and *S*, and *Q* and *Y*. Perhaps you will find it helpful to associate these letters in this way.



WHEN you defend a snow-fort, or "snow-trench" to be modern, you not only want to keep the enemy's attacking party at a distance by well-aimed snowballs, but also to escape from being hit by their snowballs. By building the walls of your fort or trench breast high, you need expose only your head and shoulders when throwing, and you can quickly "duck" behind the wall when you see a snowball coming. But the author well remembers how the lads attacking a snow fort used to wait for the defenders' heads to appear — in fact, got to know just when they would appear, — and "soaked" them before there was a chance to get into a throwing position. Probably you have had the same experience. Although this adds excitement to a snow fight, the fun is all on the side of the boys attacking. By the use of periscopes, however, the defenders can have the advantage on their side.

With a periscope, you know, a soldier sees what is going on outside of the trench, or other fortification, without exposing his head to the enemy's fire. Just so with the home-made snow fort periscope. With its top projecting above the wall of your snow fort, as shown in Fig. 571, you watch the enemy while fully protected by the fort,

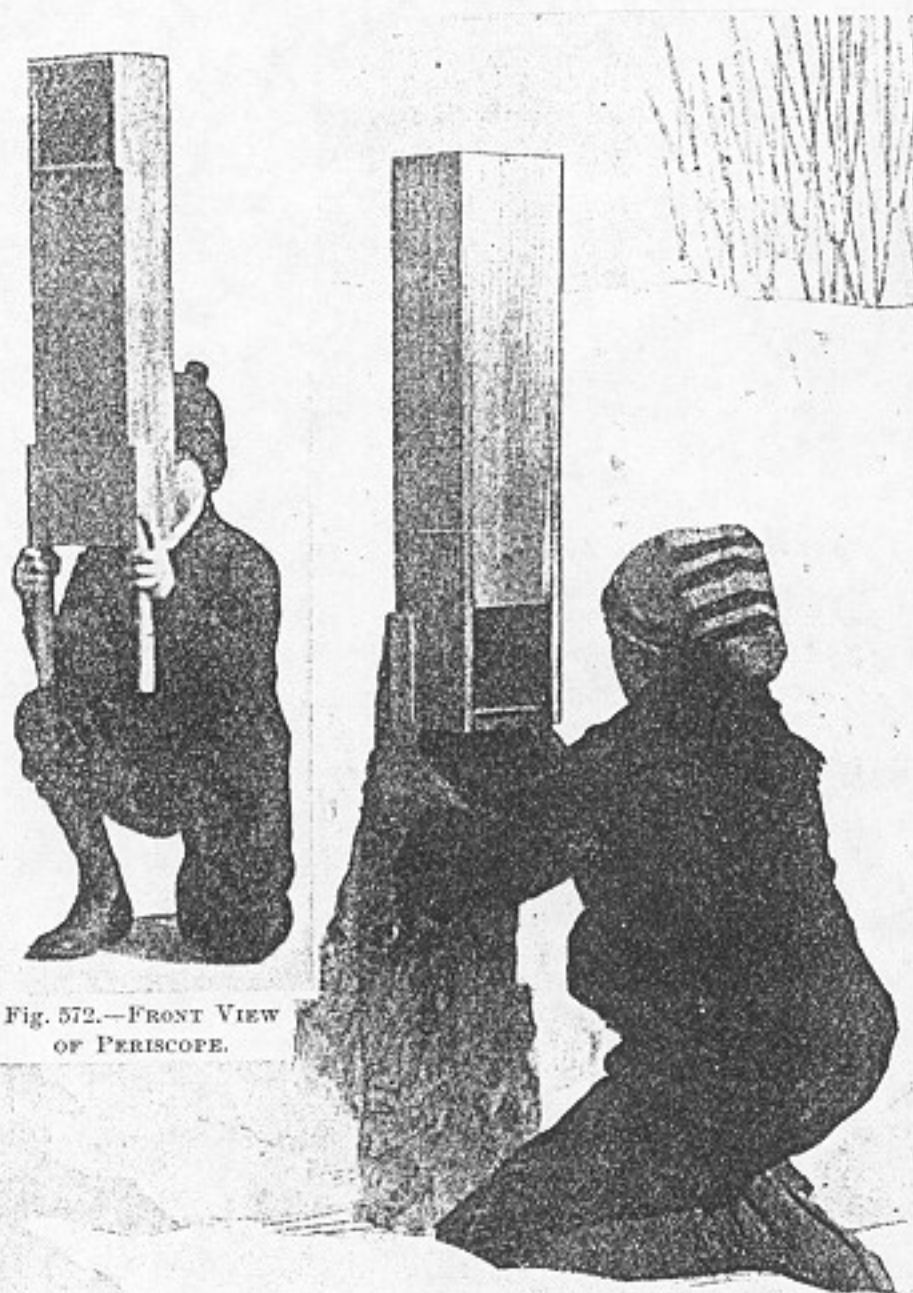


Fig. 572.—FRONT VIEW OF PERISCOPE.

Fig. 571.—WHILE PROTECTED BY THE SNOW FORT, YOU WATCH THE ENEMY THROUGH THE PERISCOPE.

and you expose yourself only when you see that nobody is prepared to throw at you. One periscope will serve several boys if one boy acts as *observer* and directs the "fire."

Figure 571 shows a rear view and Fig. 572 a front view of the home-made periscope in use, Fig. 573 shows a working detail of the completed periscope, and Fig. 577 shows a vertical section.

Material Required. Boards $\frac{3}{8}$ -inch thick were used in making the periscope model illustrated, but even thinner

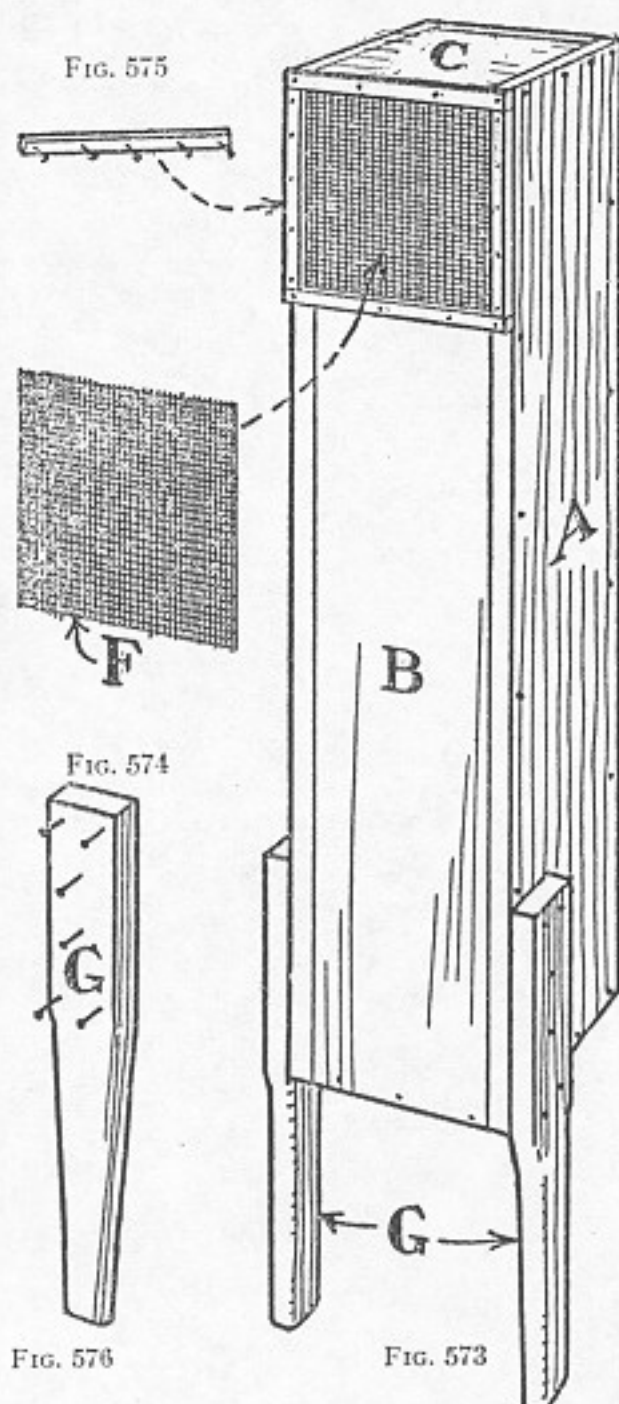


FIG. 573.—Complete Periscope. FIG. 574 and 575.—Detail of Screened Front FIG. 576.—Handle

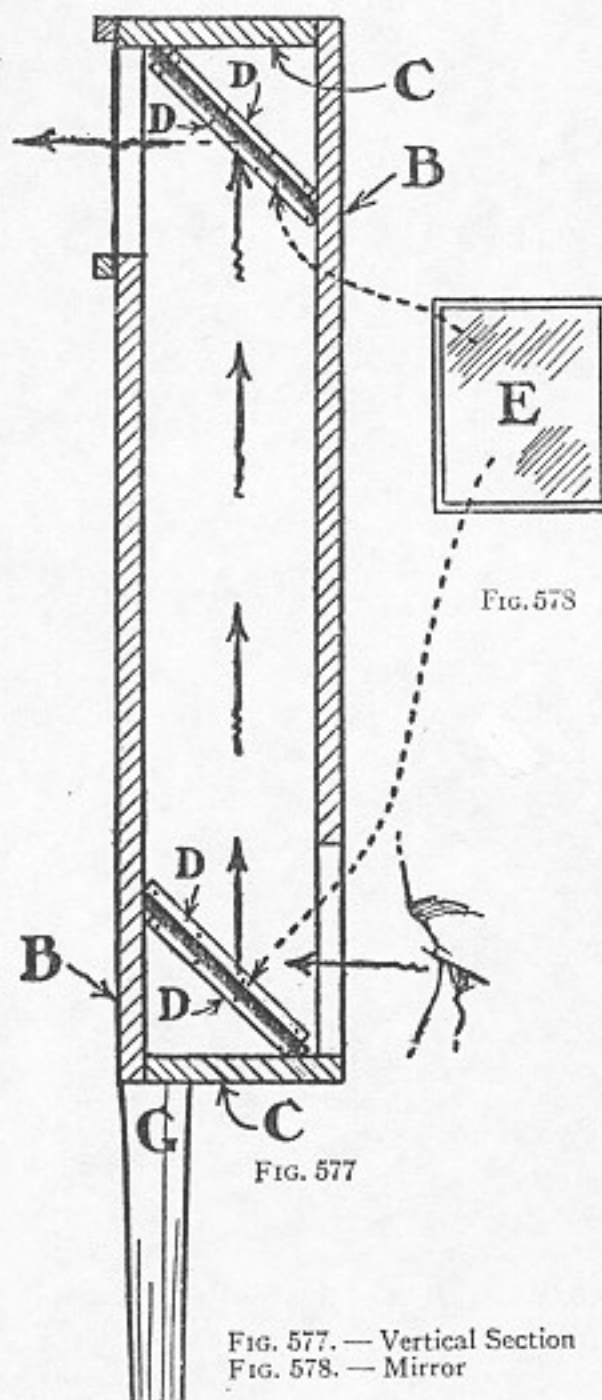


FIG. 577.—Vertical Section
FIG. 578.—Mirror

boards than this will do. The lighter the weight is, the easier it will be to handle the periscope. Perhaps you can find a packing-box made of $\frac{3}{8}$ -inch boards which you can break up for the purpose.

Two mirrors are needed. Those used for the model were bought at 5 cents apiece at a 5-and-10-cent store. They are 5 inches wide and 6 inches long. Get the mirrors before you construct the periscope box, because if they don't measure 5 inches wide and 6 inches long you will have to alter the dimensions of the side pieces to suit them.

Cutting Out the Parts. After cutting side pieces A, the front and back pieces B, and the ends C (Fig. 573), by the patterns of Fig. 579, cut eight narrow strips (D, Fig. 579) for cleats on which to support the edges of the mirrors. These strips may be cut out of cigar-box wood. Fasten the strips with brads to sides A at an angle of 45 degrees, placing a pair at each end, just far enough apart so the mirrors will slip between them, and so the ends will be far enough away from the edges of sides A to allow for the thickness of the front, rear, and end boards which are set against them. It is absolutely necessary to place the strips at one end exactly parallel with the pair at the opposite end, so that the reflecting surfaces of the mirrors will be

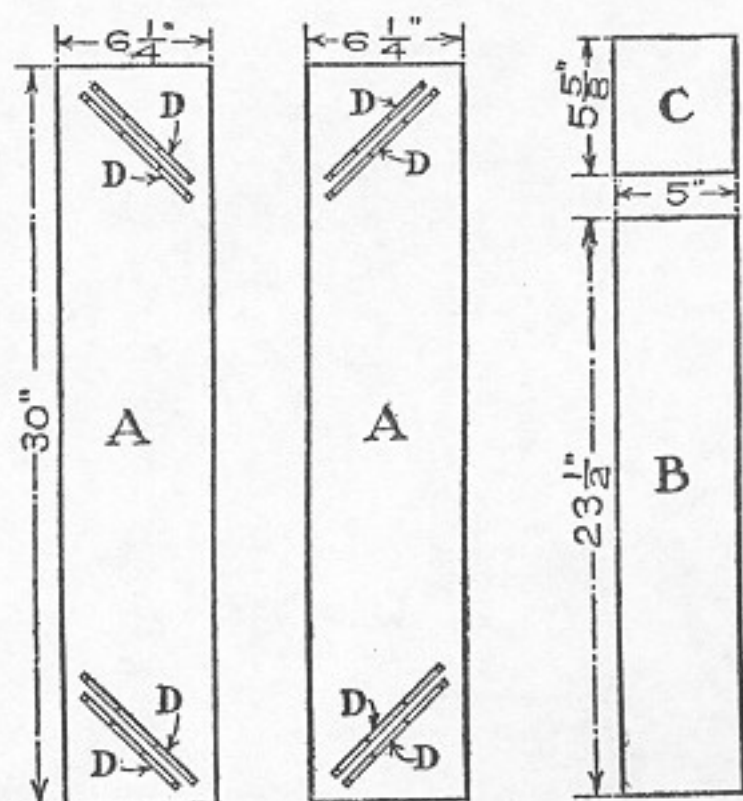


FIG. 579.—Patterns for Sides, Front, Back and Ends of Periscope

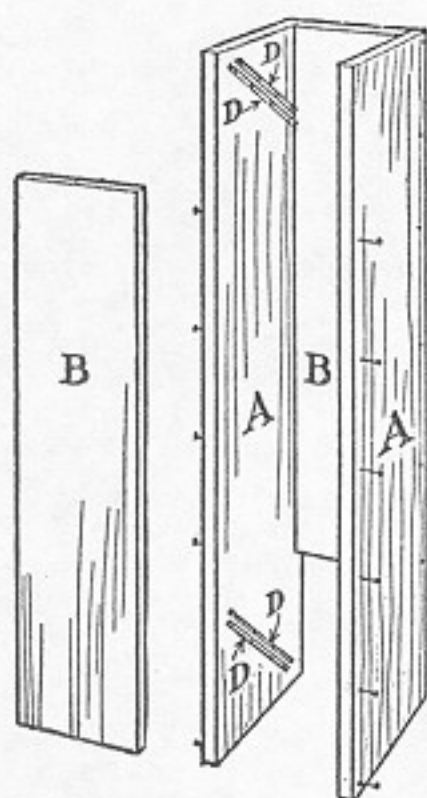


FIG. 580. — How to Assemble the Periscope Parts

parallel with one another, and, also, to place the strips on one board at the same height as those on the other board. Fasten the strips to one board, first, then use the same measurements for locating the strips upon the other board.

To Assemble the Box, first nail sides *A* to the edges of back *B* (Fig. 580), then to the edges of front *B*. Notice that the back piece comes even with the tops of the sides, and that the front piece comes even with the bottoms of the sides. With pieces *A* and *B* nailed together, fasten ends *C* between them. These pieces will hold the mirrors in position.

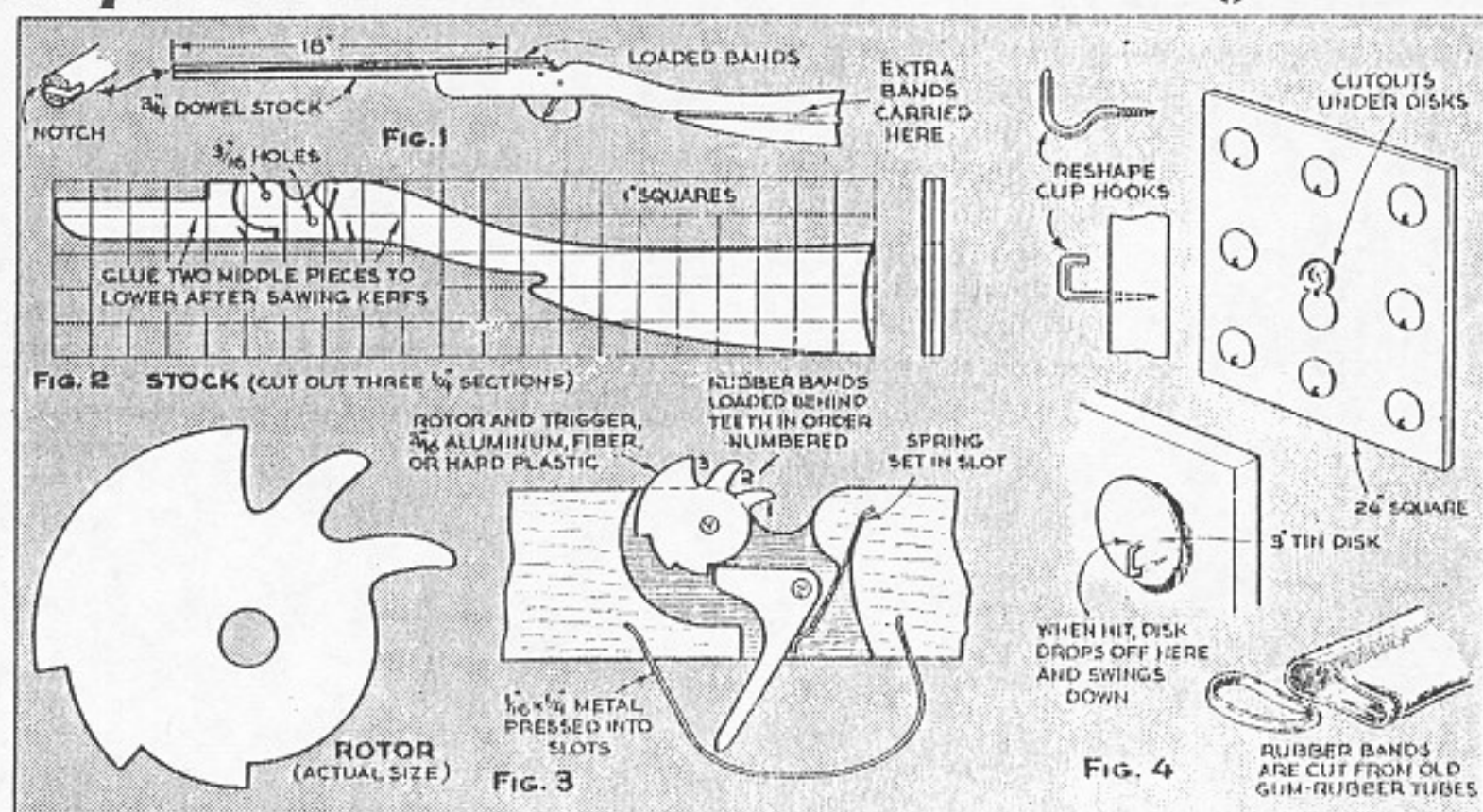
The Openings. The opening in the back of the periscope box is the one that you look into, the one in the front is turned toward the object you wish to view. As the upper mirror will be exposed it must be protected from snowballs by a piece of screen wire tacked over the opening (*F*, Fig. 574). A frame of narrow wooden strips (Fig. 575) tacked over the edges of the wire will hold the wire in place.

Handles nailed to the lower portion of the box (*G*, Fig. 576) will complete the periscope.

Paint the Periscope Box white so that it will be invisible from a distance, against the snow background.

POPULAR SCIENCE DEC. 1947

Repeater Rubber-Band Gun Gets "Big Game"



HERE'S a rubber-band gun that looks like a gun, cocks with a click, and shoots three bands one after another on one loading. By making several of these guns and a target panel, on which pictures of big-game animals are revealed when the flying bands knock aside covering disks, you will have an interesting indoor game.

Lay out the pattern of the stock on three sheets of $\frac{3}{8}$ " plywood bradded together. Then drill the two $\frac{3}{16}$ " holes and saw the stock to shape. Now separate the three sections of the stock. Cut away part of the

middle one to accommodate the trigger and rotor. Also make saw kerfs to take the trigger spring and guard.

Glue the two pieces of the middle section in their original position on one of the solid sections. After installing the rotor, trigger, and spring, put the other section on temporarily to see that everything works. If it does, glue this section in position. Notch the back 4" of the barrel to fit the stock and attach with two $1\frac{1}{2}$ " countersunk wood screws after gluing. When you use the gun, squeeze the trigger slowly.—R. R. COLE.

HARPER'S INDOOR BOOK FOR BOYS

BY
JOSEPH H. ADAMS

AUTHOR OF
"HARPER'S ELECTRICITY BOOK FOR BOYS"
AND JOINT AUTHOR OF
"HARPER'S OUTDOOR BOOK FOR BOYS"

WITH MANY ILLUSTRATIONS



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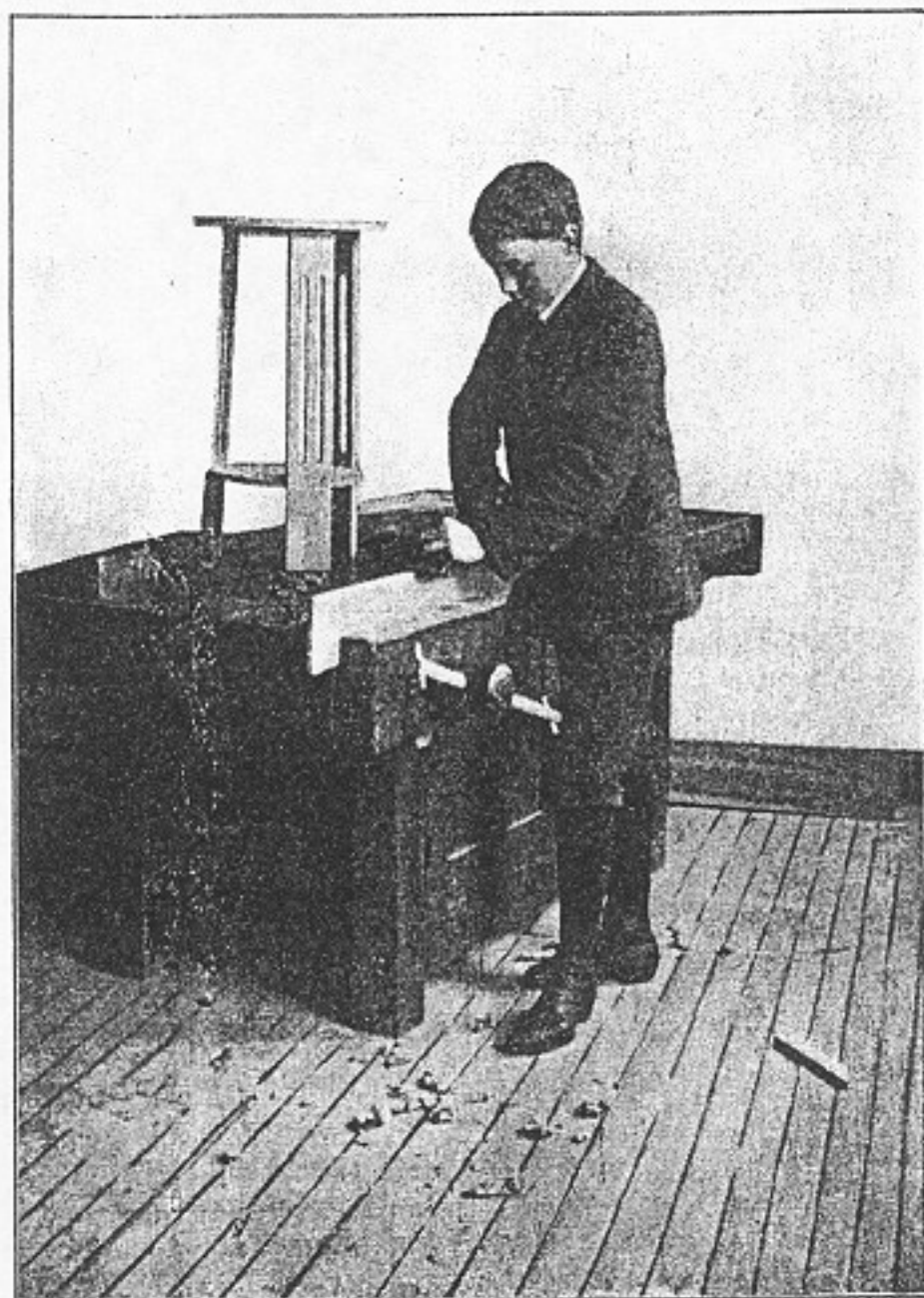
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Chapter I

CARPENTRY

CARPENTRY, or the science of making things out of wood, is the oldest and comes the closes to us of any of the applied arts and crafts. The earliest men made clubs at least. Later they began to build, to construct, and it is interesting to remember that this ability to construct is a faculty shared with man by the animals. There are many species of birds that build well-designed nests; the spider is a weaver; the bee is a geometrician; the ant is a tunnel builder; the beaver, in the construction of his dams and breakwaters, displays engineering ability of a high order. The vital difference between the animal and the human intelligence lies in the fact that the latter is progressive. The spider weaves just the same pattern to-day that he did when the Pyramids were young; the mathematical section of the bee cell is invariable; the mud-swallows build the same kind of houses as their remotest ancestors. The common explanation is that instinct and not reason guides the animal in his work, and instinct is a reproductive faculty, not an inventive one. It is for man alone to progress from the crude beginnings of an art to its highest and most perfect development.

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Perhaps the first and most urgent need of all living creatures is for shelter. The oriole weaves his hanging nest; the beaver constructs his wonderfully domed house; primitive man builds his hut of interlaced boughs. But it is man alone who is not content with the first crude efforts; he is constantly aiming after something more substantial and better adapted to his increasing needs. So man becomes the true builder, and as wood is the simple and almost universally obtainable material, carpentry, or the art of working in wood, stands at the head of the applied sciences upon which the civilization of the race depends.

The average boy takes to carpentry as naturally as ducks take to water, and beginning with the tacks a baby boy will hammer in a board, the young builder goes on from the simple to the more complex forms until he attains the full mastery of his material and his tools. He has now obtained the dignity of manhood; he is a maker of things.

Once proficient in the art of cutting, joining, and fastening wood-work, and in the use and care of tools, a boy may begin to call himself a carpenter. But he must learn to work systematically and accurately if he is ever to become a genuine craftsman. In the first place, he should understand the possibilities and limitations of his tools. He

should never use a chisel for a screw-driver, nor drive nails with the butt end of a plane. Good tools should have good care. Inanimate things that they are, they yet resent ill-usage, and retaliate, in their own way, by becoming dull and otherwise unfit for their work. Indeed, a good carpenter may be known by the condition of his tool-chest and work-bench. Carpentry, when properly carried on, is

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a most fascinating occupation for out-of-school hours, especially in the winter season, when bad weather keeps one indoors. Needless to say, it may be made a profitable way of passing time as well as an amusing one.

Tools

The tools that a boy will need in order to do good joiner-work should be the same as carpenters use, but they may be smaller and not so cumbersome to handle. The set of tools in a chest, put up for the use of children and sold at toyshops, are not the sort that can be relied upon for good carpentry work, since they are usually dull and made of soft steel that will not hold an edge. Possibly the manufacturer thinks that he is justified in turning out this kind of rubbish, bearing in mind the old saying, "Children should not play with edged tools." But the boy who is old enough to take up carpentry in earnest is entitled to the use of good and serviceable implements, and without them it is hardly worth while starting at the business.

Competition has brought down the cost of good tools to a point where they are not beyond the means of the average boy who is prepared to save his pocket-money. It is better to purchase only a small kit at first, and then to add to it from time to time, until the complete outfit is obtained.

Good tools may be purchased at nearly every hardware shop or general store throughout the country. For ordinary work you will require a good rip and cross-cut saw, with twenty and twenty-four inch blades, respectively; a claw-hammer, and a smaller one; a wooden mallet for

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chisels, and to knock together the lap joints of wood; a jack and a smoothing plane; a compass-saw; a brace and several sizes of bits, ranging from a quarter to one inch in diameter; a draw-knife; a square; awls; pliers; a rule; several firmer-chisels, and a screw-driver. There are many other useful tools, but they may be added as they are required.

It is a difficult matter to instruct a boy, by written description, how to handle tools; and rather than attempt it, I should advise the young workman to watch a carpenter at his work. Most carpenters are quite willing to have you follow their movements, and many of them will even offer advice, if they see that you are really interested. But remember that a good workman never likes to have a boy meddle with his tools, and you should not ask foolish or unnecessary questions.

Perhaps there is a carpenter's shop near your home in which the owner may let you work occasionally (if you keep out of his way), and where, in the atmosphere of the

craft, you will make faster progress than you can possibly do at home with no one to tell or show you how things should be done.

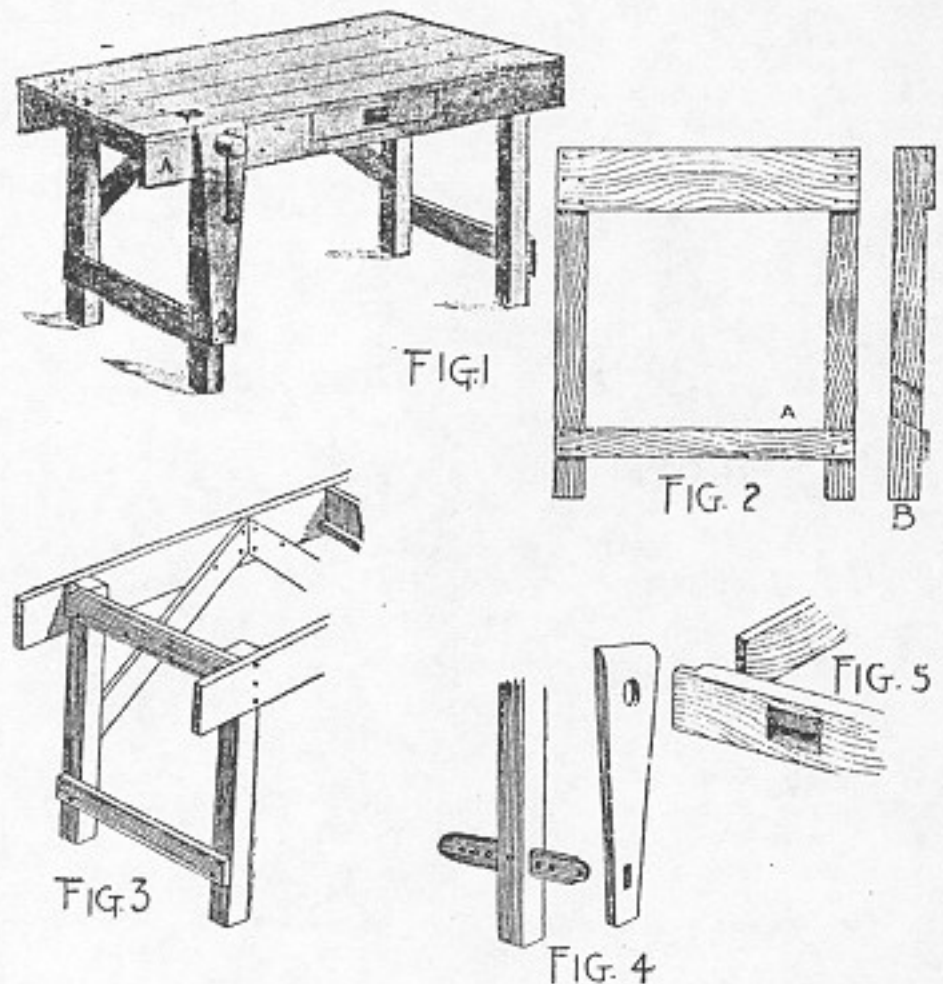
The Work-bench

One of the indispensable pieces of equipment for the boy carpenter is a good work-bench. The bench must be substantially made, and provided with a planing-stop, a vise, and a drawer in which to keep small tools, nails, screws, and the various odds and ends that are employed in carpentry.

To begin with, obtain four spruce or white-wood sticks,

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three inches square and thirty-six inches long, planed on all sides. These are for the legs. You will also need two pieces of clear pine, or white-wood, three feet long and six



inches wide, and two more the same length and three inches wide. These pieces should be one and an eighth inches thick, and planed on all sides and edges.

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Lay two of the legs on the floor, three feet apart, and join the ends with one of the six-inch strips. Six inches up from the free ends fasten a narrow strip, as shown in Fig. 2 A. This finishes one of the end supports. Flat-headed iron screws, two and a half inches long, should be used for the unions, and a tighter joint may be secured by also using glue.

Prepare, in similar fashion, the other pair of legs, and, with two pieces of clear pine, or white-wood, five feet long, eight inches wide, and seven-eighths of an inch thick, bind the four legs together, as shown in Fig. 3. You should allow the boards to project six inches beyond the legs at both ends. These pieces are the side-rails, or aprons, and

they should be securely fastened with glue and screws to the upper end of each leg.

At the back of the bench arrange two braces of wood, three inches wide and seven-eighths of an inch thick, as shown in Fig. 3. Bevelled laps are to be cut in the side of two legs, as shown in Fig. 2 B, into which the ends of the strips will fit flush. The upper ends of the strips are to be mitred (cut at an angle), and attached to the inside of the apron, as shown in Fig. 3.

For the top of the bench use clear pine planking not less than one inch in thickness. This should be fitted closely together, and fastened to the cross-pieces with stout screws.

From hard-wood a piece should be shaped for a vise-jaw thirty-two inches long, three inches wide at the bottom, and seven inches wide at the top. Near the bottom of the jaw an oblong hole should be cut to receive the end of a

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sliding piece, which in turn is provided with several holes for a peg to fit into. A corresponding oblong hole is cut near the foot of one leg, through which the piece containing the holes will pass. This last regulates the spread of the jaw. This construction may be seen in Fig. 4, and its final position is shown in the illustration of the finished bench (Fig. 1).

Near the top of the jaw a hole is cut to receive the screw that is turned with the lever-stick to tighten the jaw. A bench-screw may be purchased at any hardware store, and fitted to the work-bench. If it should prove too much of an undertaking for the youthful workman, a carpenter will put it in place at a trifling cost. The wood screws are the cheapest, but the steel ones are the most satisfactory, and will cost about one dollar for a small one.

From the apron (at the front of the bench) a piece should be cut fifteen inches long and six inches wide. This opening will admit a drawer of the same width and height, and as deep as may be desired. Twenty-four inches will be quite deep enough.

Rabbets are cut in the ends of a front piece, and the sides are let into them, as shown in Fig. 5. The bottom and back are fastened in with screws, and the drawer is arranged to slide on runners that are fastened across the bench inside the aprons, as shown in the upper corner of Fig. 3.

At the front of the drawer a cove may be cut out, and a thin plate of iron screwed fast across the top of it, so that the fingers may be passed in behind the plate to pull out the drawer (Fig. 5). It will not do to use a projecting drawer-pull, as that would interfere with pieces of work

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when clamped in the vise. In planing strips, or boards, that are too long for the vise to hold securely, a wooden peg, inserted in a hole at the opposite end of the apron from the vise, will be found convenient. Two or three holes may be made for boards of different widths, and the peg adjusted to the proper one as occasion requires.

A planing-stop, with teeth, may be purchased at a hard-

ware store and set in place near the vise-jaw. The complete bench will then be ready for use.

A Tool-rack

For the accommodation of chisels, gouges, screw-drivers, awls, compass-saws, pliers, and other small tools a tool-rack will be found convenient. It should be fastened against the wall immediately over the work-bench.

The one shown in Fig. 6 is thirty-six inches long and twelve inches high, with a ledge projecting two inches from the back-board. A leather strap is caught along the upper part of the board with nails to form loops, into which the tools are slipped.

The ledge is made from two strips of wood. One of them, one and a half inches in width, is cut with a saw, as shown in Fig. 7, and the superfluous wood, between the saw-cuts, is removed with a chisel. When all the notches are cut, a narrow strip, half an inch in width, is screwed fast to the notched strip. The ledge is then attached to the lower edge of the back-board with long screws, as indicated in the illustration.

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A Tool-cabinet

The hanging tool-cabinet shown in Fig. 8 should be constructed with two doors of nearly equal size, so that four instead of two surfaces may be available, against which to hang tools.

The body part of the chest is thirty inches high, twenty inches wide, and nine inches deep, outside measure. It is made of wood three-quarters of an inch in thickness, fastened together with screws and glue, and varnished to improve its appearance.

The right side of the cabinet is but three and a half inches wide, and to this the inner door is made fast with hinges, so that it will swing in against a stop-moulding on the opposite side, as shown at A in Fig. 9. A small bolt will fasten the door in place when shut in, and on both sides of this door hooks and pegs may be arranged for the reception of tools. The back-board of the cabinet may be used for hanging saws, squares, and other flat tools, as indicated in Fig. 8.

The outer door is provided with a side-strip (Fig. 9 B) of such size that when the doors are closed in and locked the appearance of the chest will be uniform, with a cross-section appearing, as shown in Fig. 9 C. With a little careful planning and figuring it will not be a difficult matter to construct this cabinet. Take particular care to have the doors fit snugly and close easily. The doors will keep their shape better if they are made from narrow matched boards, held together at the ends with battens, or strips, nailed across the ends of the boards, as shown in Fig. 9 D.

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Two-inch wrought butts will be heavy enough for the doors, and a cabinet-lock at the edge of the outer door will make all secure.

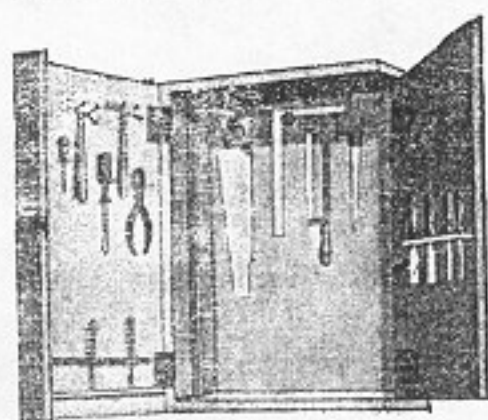


FIG. 8

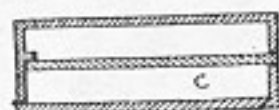
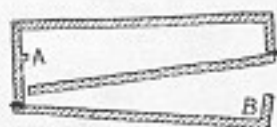


FIG. 9

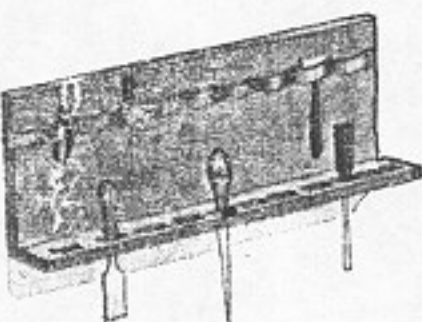


FIG. 6

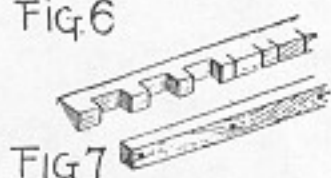


FIG. 7

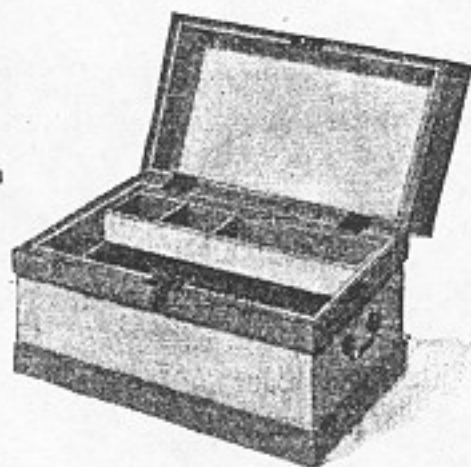


FIG. 10

On the inside of the outer door some tool-pegs may be arranged. Near the bottom a bitt-rack should be fitted,

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with a leather strap formed into loops, as described for the tool-rack. Under each loop a hole should be bored in a strip of wood, into which the square end of the bitts will fit, and thus insure their orderly position. For chisels a similar set of pockets may be designed as shown in Fig. 8.

A Tool-chest

The tool-chest shown in Fig. 10 is twenty-eight inches long, fifteen wide, and twelve inches high. This is a good size for the accommodation of a moderate-sized kit of tools. The interior fittings should include two or three trays arranged to rest on runners and to slide back and forth, so that tools may be reached at the bottom of the chest without removing the trays.

Obtain a pine or white-wood board fifteen inches wide, and free from knots or sappy places. Cut two pieces twenty-eight inches long, and two shorter ones twelve inches long. These will form the top, bottom, and ends. Cut out the front and back pieces twenty-eight inches long and twelve inches wide; then with glue and screws form a box, and let it stand a day until the glue is hard. Make the joints as perfect and tight as possible, so as to present a good appearance; then mark a line around the box two and a half inches from the top.

With a rip-saw cut the cover free from the body, and plane the rough edges of the cut, so that the cover will fit the body snugly. Bind the lid and the top and bottom edges of the chest with a strip of wood three-eighths of an inch in width, as shown in the illustration; to look well,

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the corners should be mitred. The lid is attached to the chest with stout hinges, and a lock is arranged at the front. Stout handles at the sides will be found a convenience.

Two or three coats of olive-green paint, with a slightly darker shade for the bands, will improve the appearance of the chest. To keep the hardware from rusting, the lock, hinges, and handles should receive a coat or two of black paint.

Joints

One of the first lessons for the young carpenter to learn will be that of making wood joints. Without good joiner-work there is no such thing as carpentry, and it is the sign-manual of the competent artificer. There are a great variety of joints employed in carpentry, but many of them are too complicated for the boy carpenter to make, and the simple forms will answer every reasonable requirement.

The easiest joint to make is the straight, or box, joint. It is constructed by butting the end of one board against the edge of another and nailing, or screwing, them fast.

Fig. 11 shows a lap-joint made by cutting away a portion of the wood on opposite sides of the ends which are to be joined. When fastened the wood will appear as a continuous piece. For corners and angles, where a mitre-box is not available, the lap-joint is a very good substitute, and for many uses it is stronger than the mitred-joint, and, therefore, to be preferred.

Fig. 12 is another form of lap-joint, where the end of a strip is embedded in the surface of a stout piece of wood.

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This joint will be found useful in furniture work, and also for frame construction in general.

Fig. 13 is a bevelled lap-joint, and is used for timbers and posts, particularly under conditions where the joint can be reinforced by another piece of wood at one or two sides.

Fig. 14 shows a mortise and tenon. The hole in the upright piece is the mortise and the shaped end on the stick is the tenon. The shaped end should fit the hole accurately, and the joint is usually held with a pin, or nails, driven through the side of the upright piece and into the body of the stick embedded in the mortise. The mortise and tenon is used extensively in framing, and for doors, window-sashes, and blinds. In cabinet work it is indispensable.

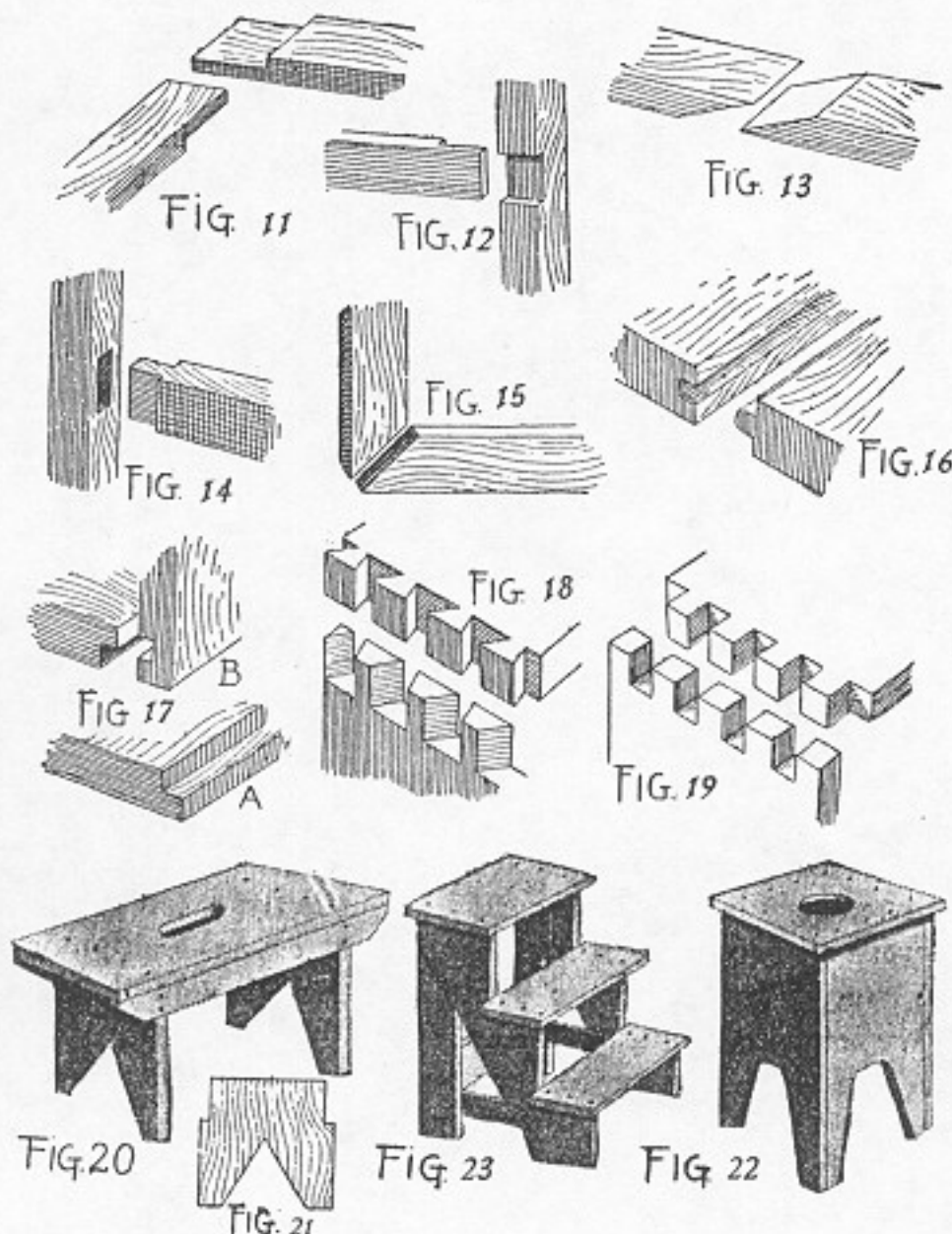
Fig. 15 is the mitred-joint. In narrow wood it is usually cut in a mitre-box with a stiff back-saw to insure accuracy in the angles. The mitred-joint is employed for picture-frames, screens, mouldings, and all sorts of angle-joints.

Fig. 16 is the tongue-and-groove joint, and is cut on the edges of boards that are to be laid side by side, such as flooring, weather-boards, and partitions. Before wood-working machinery came into general use the tongues and grooves were all hand-cut with planes, but a tongue-and-groove plane is now almost obsolete, all this class of building material being mill finished.

Fig. 17 A is a rabbet. It is cut on the edges of wood, and another similarly shaped piece fits into it. It is also

useful where wood laps over some other material, such as glass or metal. The inner moulding of picture-frames are always provided with a rabbet, behind which the edge of the glass, picture, and backing-boards will fit.

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JOINTS, RABBETS, AND BENCHES

Fig. 17 B is a rabbet-joint made with a rabbet and groove. It is a good one to employ for box corners, and where the edges of two pieces of wood come together.

Fig. 18 is the dovetail-joint used for boxes, drawer corners, chests, and sometimes in cabinet work, where the corners are to be covered with mouldings or edging-strips.

Fig. 19 is the straight dovetail employed in the cheap construction of small boxes for hardware, groceries, and other wares. Since the edges are straight, this is the easier one to make, but care must be taken to have the fitting accurate.

A Low Bench

Small benches are useful to work upon when sawing, nailing, and matching boards; and they are handy for many purposes about the house. The low bench shown in Fig. 20 is fifteen inches high and twelve inches wide, and the top is twenty-two inches long. The foot-pieces are cut as shown in Fig. 21, and at the upper end at each side a piece is cut out to let in the side-aprons. The aprons are three inches wide and seven-eighths of an inch thick; they are

held to the foot-pieces with glue and screws. In the top a finger-hole is cut so that the bench may be quickly picked up and the more easily handled.

A High Bench

The high bench shown in Fig. 22 is twelve inches square and twenty-four inches high, with a top fourteen inches square. The wood is seven-eighths of an inch thick, and

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all the joints are made with screws. A hand-hole is cut in the top with a compass or key-hole saw, and all the edges are sand-papered to round them off.

A Step-bench

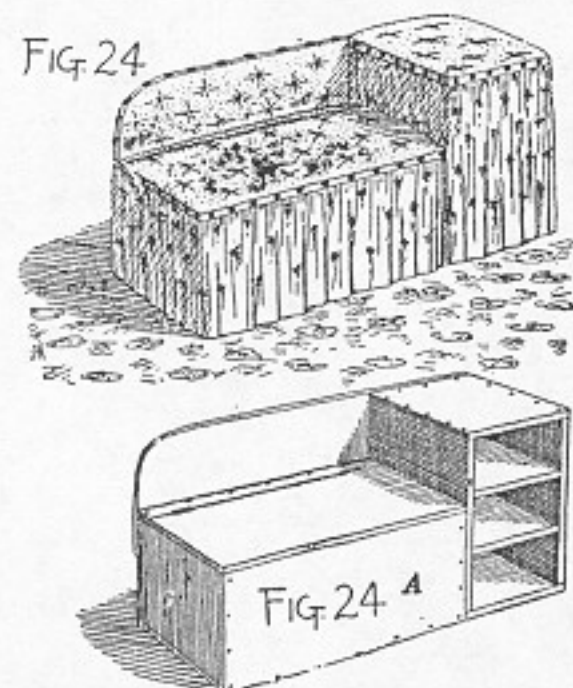
A step-bench will be found useful for various purposes. It does not take up so much room as a step-ladder and affords a more solid footing. The bench shown in Fig. 23 is thirty inches high, fifteen inches wide, and eighteen inches deep. The uprights that support the sides are five inches wide; the treads of the first and second steps are six inches wide, and that of the top step eight inches wide. The wood is seven-eighths of an inch thick, planed on both sides, and all the unions are made with screws. The cross-brace at the back and near the bottom is set into laps cut in the edges of the upright supports, and to prevent the support and side-pieces from spreading, stanchion-bars may be screwed fast to the sides, under the first tread, and to the foot of the uprights.

Two or three coats of paint will finish these benches and make them fit for use about the house.

A Shoe-box

A shoe-box and seat (Fig. 24) is a useful piece of furniture in any bedroom. Two boxes, purchased at a grocery store, may be made to serve the purpose, but for a really neat and workmanlike job the frame should be constructed of boards three-quarters or seven-eighths of an inch in thick-

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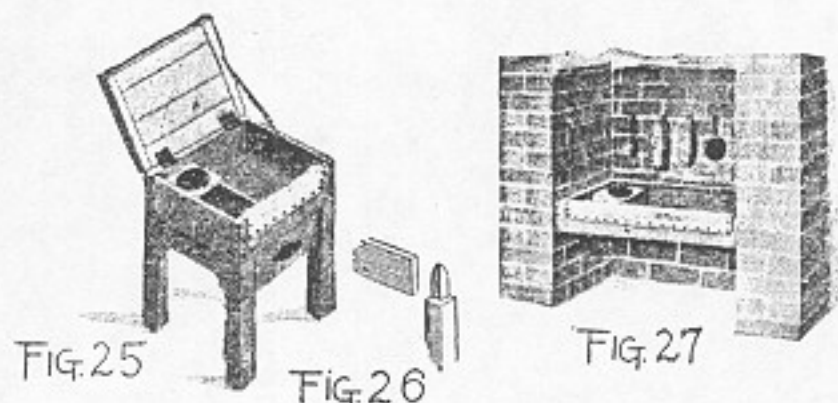


ness. A good size for the shoe receptacle is twenty-four inches high, fifteen inches deep, and sixteen inches wide. The seat-box should be thirty inches long, and fifteen inches high and deep.

These boxes are to be attached to each other with stout screws, and a back the length of the two boxes, and having a rounded corner is to be securely fastened to the rear of each box, as shown in Fig. 24 A. In the shoe-box two shelves are screwed fast, and to the lower box a corner should be arranged on hinges so that it may be raised from the front. The back and seat and also the top of the shoe-box should be covered with denim, under which a padding of hair or cotton may be placed. The denim should be caught down

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with carriage-buttons and string, the latter being passed through holes made in the wood and tied at the underside. Around the front and sides a flounce of cretonne or denim may be gathered, and hung from the top edge of the box and seat. If finished with gimp and brass-headed tacks it will present a good appearance. Where the drop-curtain at the edge of the shoe-box meets the seat the fabric is to



be divided, in order that it may be drawn to one side when taking out or replacing shoes.

A coat of shellac, or paint, will cover such parts of the wood-work as are not hidden by the upholstery. Fig. 24 shows the finished article of furniture.

A Shoe-blackening-box

Every boy should own a shoe-blackening-box, such as is shown in Fig. 25. Otherwise, the brushes and blackening-box are apt to get widely separated, and are never at hand when they are wanted. Moreover, it is a slovenly practice to use a chair or stool as a foot-rest when engaged in polishing

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one's shoes, since the blacking is sure to discolor and dirty whatever it touches. This shoe-blackening-box is twenty-four inches high and eighteen inches square, the compartment being four inches deep. Four sticks, two inches square and twenty-four inches long, will form the legs. Each stick should be cut away at one end three-quarters of an inch deep for a distance of five inches, as shown in Fig. 26, so that when the side boards are fastened to them the joints will be flush. Two sides of each stick should thus be cut away, and the small end of the stick may be tapered slightly. The side boards, of three-quarter-inch wood and five inches wide, are screwed fast to the top of the legs.

A bottom sixteen and a half inches square is cut from boards and fastened inside the frame, where it is held in place with steel-wire nails driven through the lower edge of the side boards and into the edge of the bottom, all around.

Four brackets are cut and fastened with screws at each side of the box, under the side boards. A cover is made and hinged to the box, where it is prevented from falling too far back by a chain attached to the underside of the lid and to the inside of the box.

Over the front edge of the box bend a strip of zinc and tack it fast to both the in and outside of the front board. This will prevent shoes from chafing the wood away, and is easily cleaned when muddied up.

With a thin piece of wood make a division in the box at one side, where blacking and daubers may be kept. Also a drawer may be fitted to slide in and out under the box. It should be constructed as described for the work-bench, and arranged to work on runners fastened to the inside of

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the legs. Screw-eyes or staples should be driven into the ends of the brushes and daubers, so that they may be hung up in an orderly manner on hooks set in the wall immediately over the ledge.

A few thin coats of olive-green or light-brown paint will add to the appearance of this shoe-blackening-box, and the owner should take pride in keeping it clean, and the brushes in good order.

A Shoe-blackening-ledge

In a cellar where one of the chimneys is built with a recess, a shoe-blackening-ledge may be made from four boards five inches wide. The bottom is slatted, so that dirt will fall through. Fig. 27 shows quite clearly how this can be done. One end is partitioned off to hold the box of blacking.

The ledge is twenty-four inches high, and the front board is bound with a strip of zinc along the upper edge. The blackening-brushes may be kept in the tray, but it is a better plan to hang them up against the brick-work on steel nails. If the brushes are to be kept inside the tray, a lid should be made and hinged to the back strip of the tray. When the lid is raised it may be held against the brick wall with a wooden button.

An Easel

Boys who have a talent for drawing and painting would undoubtedly like to have an easel on which to work, and a good strong one may be made, at moderate cost, in the following manner (Fig. 28).

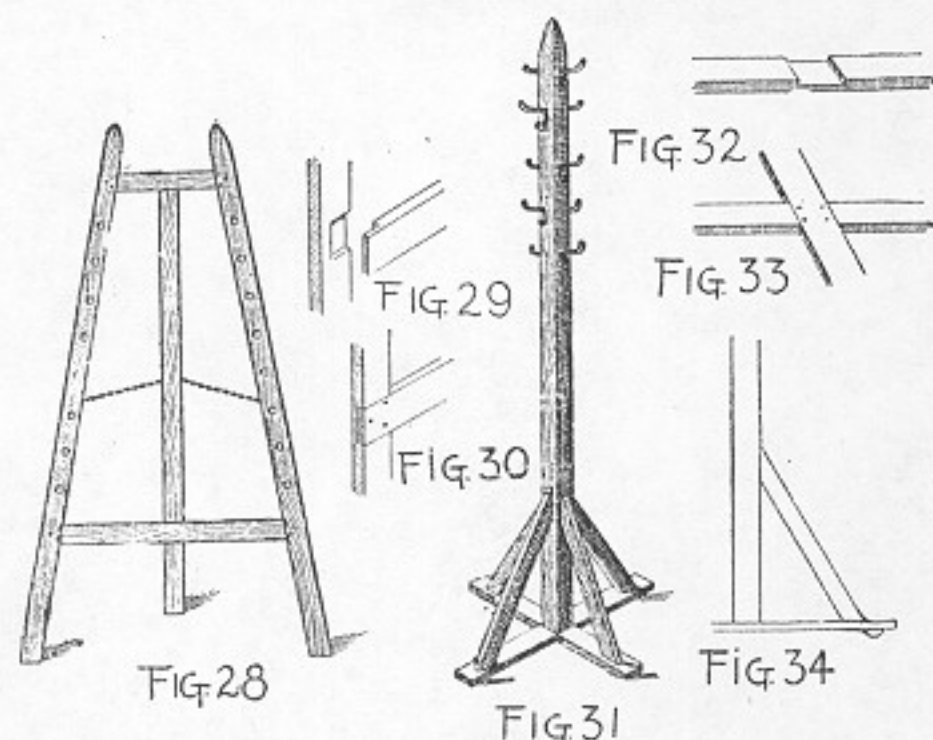
Obtain four pieces of clear white pine six feet long, two

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and a half inches wide, and seven-eighths of an inch in thickness. These should be planed on all sides. Two of the sticks should be tapered off at one end, and slightly bevelled at the other. Nine inches from the top and twelve inches up from the bottom laps are to be cut in the sticks at the back, as shown in Fig. 29. Into these the ends of cross-pieces will fit. If the concealed lap is too both-

ersome to make, it can be cut clear across the sticks, as shown in Fig. 30. Glue and screws will make a strong joint.

The remaining long stick is the back support, or leg, and



is to be hinged to the upper cross-piece. With this leg the easel may be pitched at any angle, and to prevent it from

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going back too far a guide-chain should be attached to the leg, and the ends secured to the back of each upright with staples. Holes are bored along the uprights at even distances apart, and two wooden pegs are cut to fit snugly in the holes, and so hold a drawing-board or canvas-stretcher.

A Clothes-tree

A clothes-tree is a most serviceable article of furniture, and helps a boy to form habits of neatness and orderliness in the care of his wearing apparel. To make the one shown in Fig. 31 obtain a clear pine or ash stick one and a half inches square and five feet long for the upright, or staff. Also two pieces eighteen inches long, two inches wide, and three-quarters of an inch thick for the feet; and four braces twelve inches long, one and a half inches wide, and three-quarters of an inch in thickness.

Cut a lap in the middle of each foot-piece, as shown in Fig. 32, and with glue and screws fasten them securely together, as shown in Fig. 33. Screw this foot fast to the bottom of the upright stick, and strengthen the four projecting feet with braces bevelled at the ends, so that they will rest against the upright and on the foot, where they can be fastened with screws, as shown in Fig. 34. Under the end of each foot, the half of a small wooden ball, or a castor, may be arranged to raise the tree from the floor. With a chisel and plane taper the top of the upright stick, as shown in Fig. 31.

At a hardware store purchase eight hooks and arrange them in alternating pairs, as shown in the drawing. The

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wood-work should be shellacked or painted to give it a finished appearance.

When hanging clothes upon this tree place the coat, vest, and trousers on the lower hooks, the shirt and underclothing on the hooks next above, and on the top hooks the necktie and collar and cuffs. When dressing, the clothing needed first will then be the nearest to hand.

Hanging Book-shelves

In a room where space cannot be given up to a standing bookcase, it may be possible to arrange a set of shelves to form a book-rack that will hang against the wall. The construction of the hanging shelves shown in Fig. 35 is very simple, and will require but a few boards, two wall-strips, and a few yards of strong rope.

For the shelves, obtain five pine boards eight inches wide, seven-eighths of an inch thick, and from three to four feet long; also two pine strips three inches wide, an inch thick, and four feet long. In the rear edge of each board, at the ends, cut notches three inches long and an inch wide, as shown in Fig. 35 A, into which the wall-strips will fit. Round off the top of each wall-strip and screw them fast to the notched edges of the shelves, first boring gimlet holes in both strips and shelves to prevent splitting of the wood.

Half-inch holes at the top of each wall-strip will admit the suspension rope, which is of manila, and half an inch in diameter. Knot one end of the rope and pass it up through holes made at the outer corners of each shelf, and finally through the hole at the top of the wall-strips, and cut it off

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three inches back of the hole. With a gouge-chisel a groove should be made at the back of the wall-strip for an inch or two below the hole, so that the rope end may be carried down and ravelled out. It can then be glued and held fast to the wood with staples. Where the rope passes through the hole in each shelf, drive several long steel-wire nails into the edge and end of the board, allowing the nails to pass through the rope and into the wood.

Paint or varnish the wood-work, and securely anchor the wall-plates with stout screws driven into the frame timbers, through the lath and plaster of the wall.

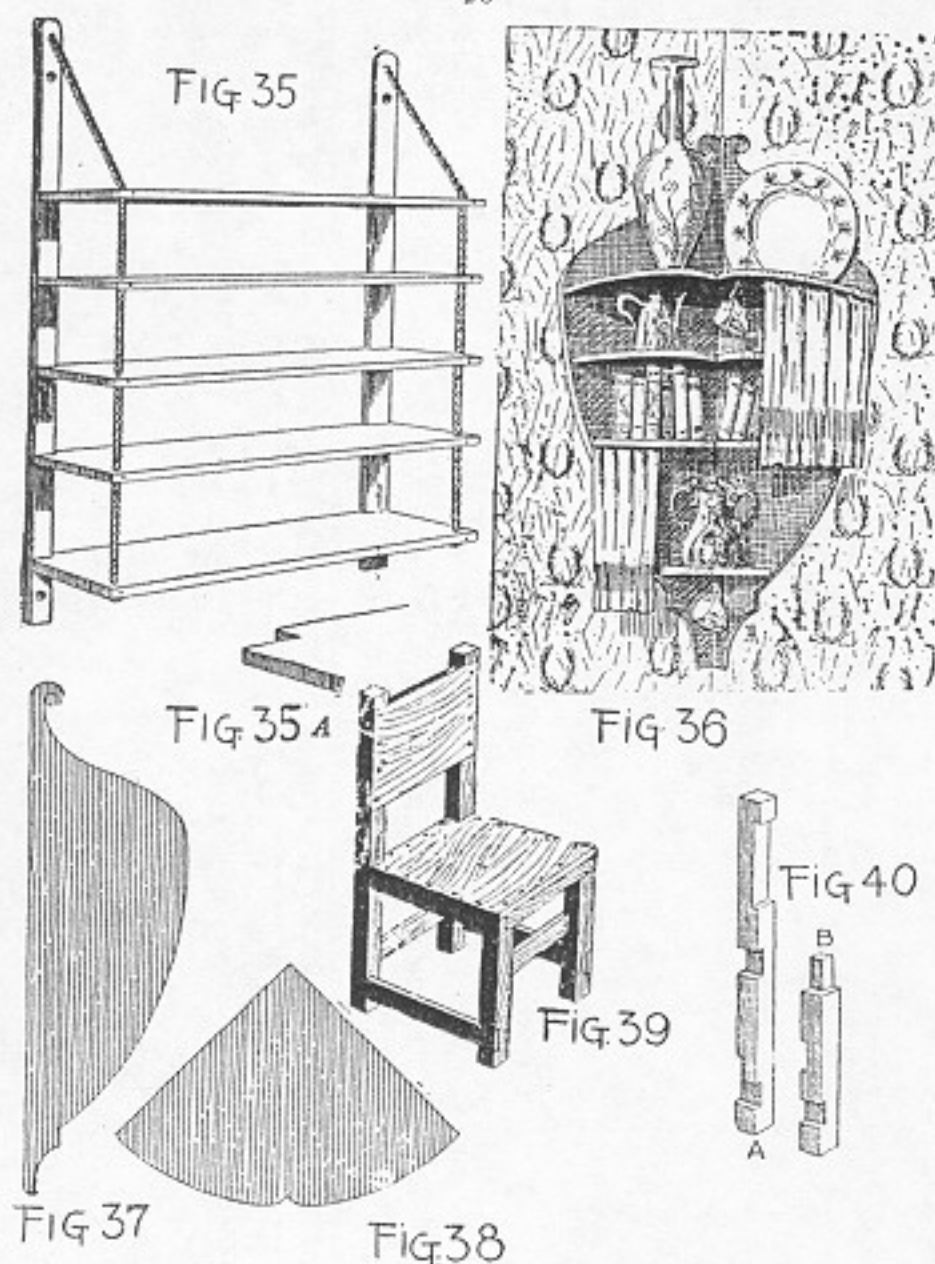
A Corner Cabinet

A corner cabinet of odd design and simple construction is shown in Fig. 36. The total height of the wall-plates should be thirty-four inches, and at the top the shelf measures eighteen inches across. Each shelf is rounded out at the front so as to afford more surface on which to place books and bric-à-brac. The ends of each shelf are securely attached to the side or wall-plates with screws, thus insuring a perfect anchorage and a strong construction.

Fig. 37 is a plan showing the shape of the sides or wall-plates. At the widest part they should measure twelve inches across. Fig. 38 is a plan of the top shelf, which is followed in shape by the others. They decrease, however, in size as they near the bottom. The notch at the middle of each shelf breaks the long curved line in a pleasing manner.

Two light metal rods from which curtains hang may be arranged under the top shelf and the one next the bottom.

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HANGING BOOK-SHELVES AND CHAIR CABINET

Shellac or paint of some appropriate shade will add to the appearance of this useful piece of furniture.

When fastening this cabinet to the wall, care should be taken to pass the screws securely into the studding or up-rights. Otherwise the screws might pull out under the accumulated weight, and a fall would be disastrous to both the cabinet and its contents.

A Chair

The construction of a chair is perhaps as interesting as anything in carpentry. The one shown in Fig. 39 may be made from either soft or hard-wood, the joints being all open and simple to cut.

The legs are two inches square, the seat is sixteen inches square and eighteen inches high, and the back posts are thirty-six inches long. The front and back posts are cut out, as shown in Fig. 40 A and B. These receive the cross-pieces that bind the legs and back together. The posts are two inches wide and three-quarters of an inch thick. The side braces are set two inches up from the floor and the back one four inches. The front brace is let into the rear of the front legs, and is eight inches from the floor to the lower edge.

The seat is made from matched boards, and the back, ten inches wide, is made from a single board, all the joints being glued and screwed together. Chairs that are made in shops usually have the joints dowelled or mortised, but the lap-joint is the easiest and strongest one to make. Take care, however, that the cuts are accurately sawed, and that

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the cross-pieces fit the laps so snugly that a mallet is necessary to help drive the strips home.

The seat and back of this chair may be covered with denim, leather, or other upholstery material, drawn over curled hair, or cotton may be used for padding, and fastened down around the edges with large flat-headed tacks or upholstery nails. Shellac, varnish, or paint may be used to give the wood-work a good appearance.

A Table

It is not so difficult as it may seem to make a good strong table, but care and perseverance must be exercised to obtain a satisfactory result. When constructing a table bear in mind that every joint should be made to fit accurately; otherwise it will quickly rack and become useless. The proportions and shape for a serviceable table are shown in Fig. 41. Only well-seasoned wood should be employed, and it should be free from knots or sappy places.

For the legs, obtain four sticks thirty-three inches long and two and a half inches square. From two sides, near the end of each stick, cut the wood away for five inches to a depth of seven-eighths of an inch, as shown (at the top) in Fig. 40 B. Now cut two boards five inches wide and forty-two inches long, and four more thirty inches long for the frame. Six inches from the uncut ends of the legs saw and chisel out laps, so that two of the thirty-inch lengths will fit into them, and with two long and two short boards unite the legs, thereby forming a frame thirty inches wide, forty-two inches long, and thirty-three inches high. An under-

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shelf may be made twelve inches wide and long enough to extend two or three inches over the cross-strips.

The table top extends over the framework for three inches all around, and it is made of narrow tongue-and-grooved boards driven together and screwed down to the band around the top, formed by the thirty and forty-two-inch boards. To finish this top nicely it may be covered with felt, or with imitation leather, in old-red, green, or brown shades, caught under the edge and made fast with stout tacks.

A Settle

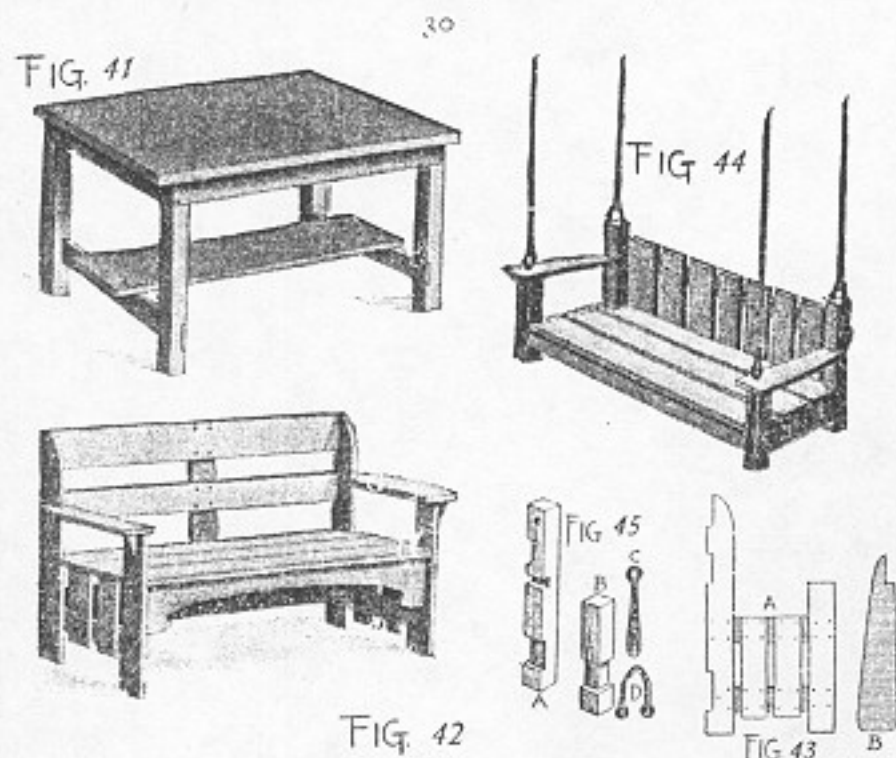
A comfortable settle (Fig. 42), for the piazza or yard, may be made from pine, white-wood, cypress, or almost any other wood that may be at hand.

It is fifty-four inches long, eighteen inches wide, and the seat is eighteen inches above the ground. The sides are made from strips three inches wide and seven-eighths of an inch thick, as shown in Fig. 43 A. The arms are twenty

inches long, six inches broad at the front, and cut the shape shown in Fig. 43 B. The notches or laps cut in the rear posts are to let in the strips forming the back and lower brace.

The joints should be made with screws rather than nails, as they hold better and do not work loose. Small brackets support the arms at the front corner posts, and a batten at the middle strengthens the back of the settle. A close inspection of the drawings will show the joints clearly and indicate how the frame is put together. A few coats of paint will finish the wood nicely, or it may be stained and

Two yokes bolted to the top of the back posts and eye-straps for the front posts will anchor the chains securely to the settle. The yoke is shown at Fig. 45 C, and the eye-strap at Fig. 45 D. A bolt passed through the top of the rear posts and through the holes in the yoke will secure the latter firmly, and a nut will prevent it from slipping loose. Holes are made in the arms, and the eye-straps are passed down through them and attached to the front corner posts with screws, as shown in Fig. 44. The back of the settle is composed of boards four inches wide and placed an inch apart.



varnished if the wood has a pretty grain. Cushions and a sofa-pillow or two will add to the comfort of this commodious seat.

A Suspended Settle

A suspended settle (Fig. 44) is a convenient piece of piazza furniture, and not a difficult thing for the young carpenter to make.

The corner posts are two and a half inches square, and the boards used in its construction are seven-eighths of an inch thick and four inches wide. The seat is forty-two

inches long and eighteen inches wide, and the back is fifteen inches high from the seat. The arms are cut as shown in Fig. 43 B, and securely screwed to the corner posts. The frame-pieces supporting the seat-boards are let into the back and front posts, in which laps have been cut, as shown at Fig. 45 A and B. They should be securely fastened with flat-headed screws. Both the rail to which the backing-boards are attached and the rear ends of the arms are let into the corner post and fastened with screws.

The seat is suspended from the ceiling of the piazza on four chains that may be purchased at a hardware store or from a ship-chandler, or they may be made by a blacksmith from iron three-eighths of an inch in diameter. If it is not possible to obtain the chains, rope may be substituted, but it will not look or last so well.

A Coal and Wood Box

A combination box for coal and wood may be made from an ordinary shoe-box, the sides and one end being cut down

as shown in Fig. 46; but a more serviceable one is constructed of boards seven-eighths of an inch thick, planed on both sides, and with the joints securely glued and screwed.

The sides are twenty-six inches long and twelve inches high at the back. At the front they are but four inches high. A back-piece ten inches wide and twelve inches high is cut and fastened in place, and a front strip four inches high is also made fast with glue and long, slim screws.

A division-board is placed in the middle of the box, as indicated by the line of screw-heads, and a bottom, ten by twenty-four inches, is held in place with screws passed through the lower edge of the front, back, and sides, and into the edges of the bottom.

A lid the width of the box is hinged to a cross-strip over the partition. A handle at the lower end will make it easy to lift the lid. Blocks with the corners rounded off will serve as feet, one at each corner.

Thin stain and two coats of varnish will finish the wood-work on the outside. A coat or two of asphaltum varnish will be better for the inside.

Sticks of wood for the open fire or kindling for the grate fire may be kept in the square receptacle, while under the lid at least two bucketfuls of coal may be stowed away. If the fuel-holder is used only at the open fire, logs may be stood on end in the square box, and kindling may be kept in the covered half.

A Flat-iron Holder

A rack of shelves to hold flat-irons may be made of white-wood or pine seven-eighths of an inch thick, the several

pieces being securely fastened together with screws. Two side-plates are cut four inches wide and thirty inches long. The tops are bevelled and the bottom of each piece is curved, as shown in Fig. 47.

The shelves are two inches wide and eighteen inches long. They are spaced eight inches apart, having the front edge flush with the edge of the side-plates, and leaving a space two inches wide from the rear edge to the wall. Wall-plates two inches wide are let into the rear edge of the side-plates two inches above the shelves. Against these the

FIG. 46

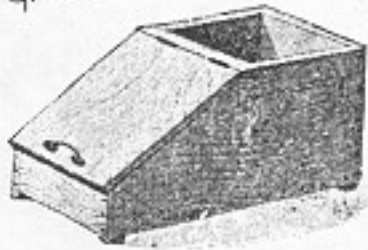


FIG. 47

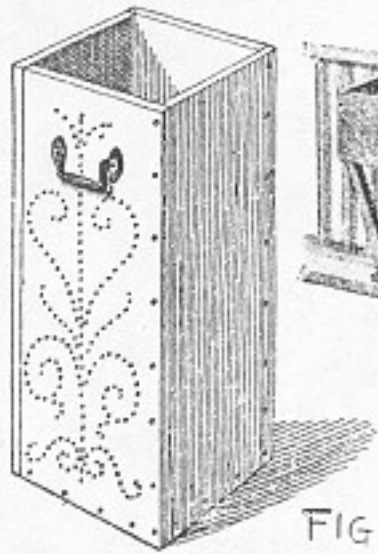


FIG. 48

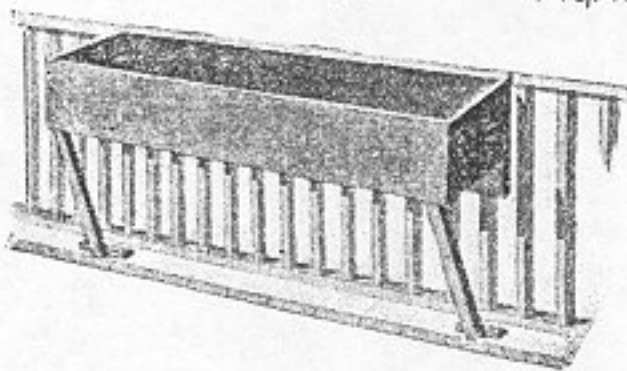


FIG. 49

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bottom of the irons will rest.

A top and a bottom board, cut as shown in the illustration, are to be attached to the wall-plates, and the complete rack of shelves should be fastened to the kitchen or laundry wall with stout screws set firmly into the studding.

Two coats of olive-green or brown paint will finish this holder nicely, or it may be painted any color to match the wood-work in the kitchen or laundry.

An Umbrella-stand

An umbrella-stand does not occupy much space, and it is a convenient receptacle for umbrellas, canes, ball-bats, and golf-clubs (Fig. 48).

To make one it will require four pieces of clear pine or white-wood thirty inches long, ten inches wide, and half an inch in thickness. There is also a bottom board nine and a half inches square and seven-eighths of an inch thick, to which the lower ends of the boards are to be screwed fast. A high, narrow box is to be formed of the boards, one side of each board being attached to the edge of the next one, as the illustration shows. Shellac or varnish will give the wood-work a pleasing finish, especially if it is white-wood, cypress, or spruce.

A design may be worked out on one side with large oval-headed hob-nails painted black. These may be purchased at a shoemakers for a few cents a paper. The design should

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first be drawn on thin brown paper and held on the wood with pins. The nails are driven along the lines of the ornament, but before they are hammered home, the paper should be torn away so that none of it is caught under the nail-heads.

A zinc tray six inches high, and made to fit in the bot-

tom of the box, will hold the drippings from wet umbrellas. Rings soldered at the top edge of the tray will permit it to be removed for cleaning.

A Plant-box

For growing plants and flowers that always look well around a piazza rail, the plant-box shown in Fig. 49 will be found useful. One or more boxes may be made from pine boards an inch thick and eight inches wide. The boxes should be six inches deep, outside measure, and they may be as long as desired to fill the spaces between the piazza posts.

Straight or box joints are made at the corners and fastened with screws. The inside of the boxes should be treated to several successive coats of asphaltum varnish to render them water-proof. Several small holes must be bored in the bottom of each box to drain off surplus moisture, and the boxes and supports may be painted a color to match the trimmings of the house.

To anchor the boxes, screw a batten to the balustrade, on which the inner edge of the box may rest. The outer edge is supported by means of braces attached firmly to the underside of the box and to the piazza floor, as shown in

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the illustration. Two small brackets attached to the underside of the box and to the batten will hold the box in place and prevent it from slipping off the top of the batten.

A Final Word

The few objects shown and described in this chapter are, of course, but a small part of the things a wide-awake boy will think of and wish to make. The principles involved in these examples, however, will apply to scores of other things that may be constructed. Once these simpler forms of workmanship are mastered the young craftsman will go forward naturally to the higher exercise of his art. Carpentery is a fascinating occupation, and it is well worth while, since its results are of practical use and value.

Chapter II

WOOD-CARVING

A KNOWLEDGE of drawing and modelling will be most helpful to the young carver, as then the outline of ornament can be readily drawn, while to carve objects from wood the art of modelling form is most desirable.

If the beginner possesses a knowledge of form acquired by drawing and modelling, the art of wood-carving may be readily and quickly mastered; but even if these advantages should be lacking, it is possible that considerable progress can be made by those who will follow the instructions given on these pages.

The most important feature of carving is the ability to sharpen and maintain the little tools, and when this is mas-

tered, more than half the difficulty has been overcome. The dexterity to handle, with a firm and sure hand, the various chisels and gouges comes, of course, with practice only.

It is better to begin with a soft wood. Pine, poplar, button-wood, cypress, or red woods are all of close grain and are easy to work. The harder woods, and those with a very open grain—such as chestnut, ash, and oak—should

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not be carved until the first principles are learned in the softer woods.

Carving takes time, and it is not an art that can be quickly mastered, unless it be the chip-and-line variety. But this last can hardly be compared to the more beautiful relief-carving, with its well-modelled form and undercutting.

A boy may learn the first principles of carving, using only his small, flat carpenter's chisels and gouges; but for more advanced work he will need the regular carving-chisels. These latter are sharpened on both sides, while the carpenter's chisels are ground on one side only. Nevertheless, some very good work has been done by boys who had nothing better than a small gouge, a flat chisel, and a pen-knife. The true artist can work in any material and with the most indifferent of implements.

Tools

At the start a numerous assortment of tools will not be necessary, as the flat work and chip-carving will naturally be the first department of the art to be taken up by the young carver.

Six or eight chisels constitute a good set, and those shown from Fig. 1 to 6 will answer very well. Fig. 1 is a plain, flat chisel with a straight edge, as shown at A; it is commonly called a firmer. Fig. 2 is also a flat tool, but possessing an angle or oblique edge; it is commonly called a skew-firmer. Figs. 3 and 4 are gouges. Fig. 5 is a V gouge, and Fig. 6 is a grounder. G, H, I, J, and K are gouges of various circles. L is an angle, or V, gouge. M, N,

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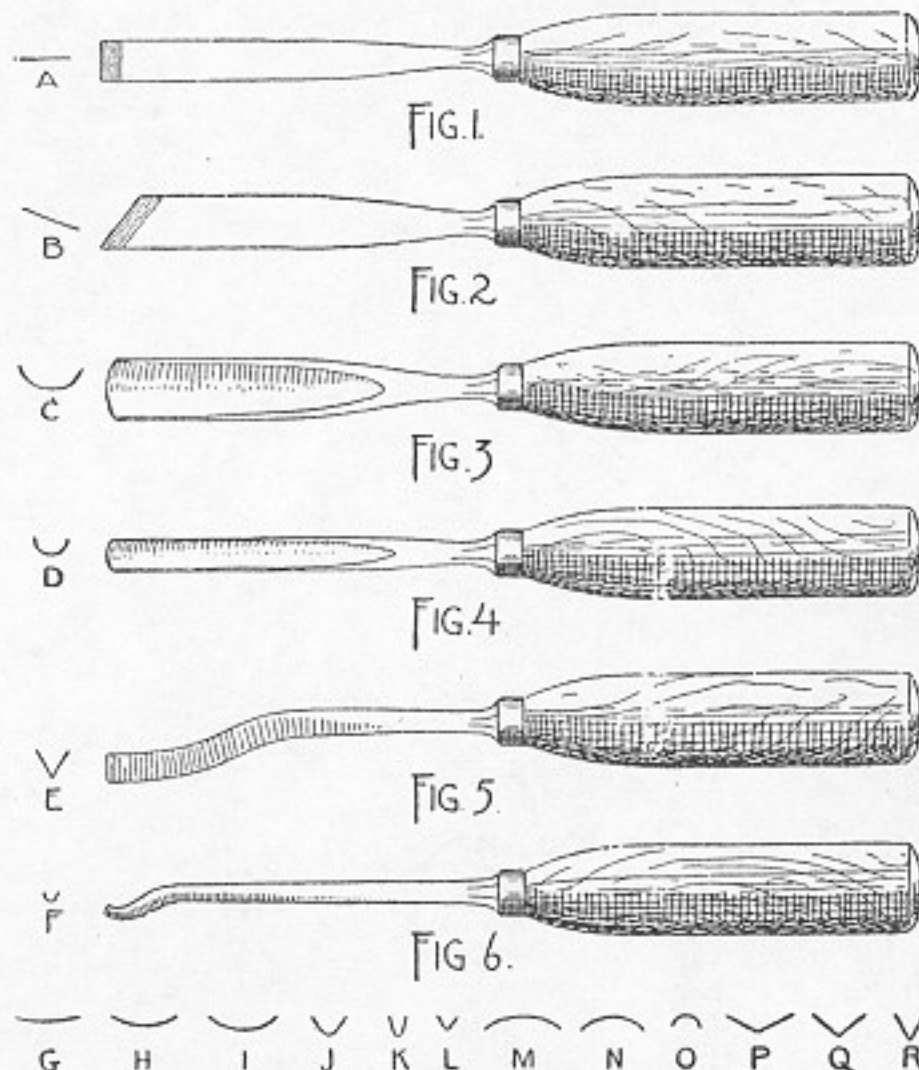
and O are gouges of various curves, and P, Q, and R are V gouges of various widths and angles. These last are used for furrows, chip-carving, and lining.

A flat felt or denim case should be made for the tools, so

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that they may be kept in good order. It is made of two strips of the goods, one wider than the other. Two edges are brought together and sewed, and lines of stitching form pockets for the chisels. The flap left by the wider strip of goods is folded over the chisel ends, and the pockets containing the tools may be rolled up and tied with tape-strings. When opened it will appear as shown in Fig. 7. The edges of chisels kept in this manner are insured against injury and rust, since the case protects them from atmospheric moisture.

The stones needed for sharpening the tools will be an ordinary flat oil-stone (preferably a fine-grained India



stone), and two or three Turkey or Arkansas slips, four or five inches long, having the shapes shown in Fig. 8. A, with the rounded edges, is for the gouge tools; B, with the sharp edges, is for V-shaped tools; and any of the flat chisels may be sharpened on the regular oil-stone, C.

In Fig. 9 end views of some slips are shown. A and B are round-edged slips for gouge-chisels; C and D are angle stones for V chisels; while small, flat tools may be finished on the sides. These stones are held in the hand, and lightly but firmly rubbed against both surfaces of a tool to give it the fine cutting edge.

In Fig. 10 an oil-stone in a case is shown. A boxed cover fits over it and protects it from grit and dust. This is important, for often a little gritty dust will do more harm to the edge of a fine tool than the stone can do it good.

The other tools necessary to complete the kit will be several clamps, similar to those shown in Figs. 11 and 12, and a fret-saw (Fig. 13). If you happen to possess a bracket-

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machine or jig-saw the fret-saw will not be necessary. A glue-pot will also be found useful.

The first essential to good, clean cutting is that the tools shall be absolutely sharp and in a workman-like condition. It is often the case that an amateur's tools are in such a state that no professional carver could produce satisfactory results with them. And yet the variety of carving tools is

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so limited that if the difficulties of sharpening a firmer and gouge are mastered the task is practically ended.

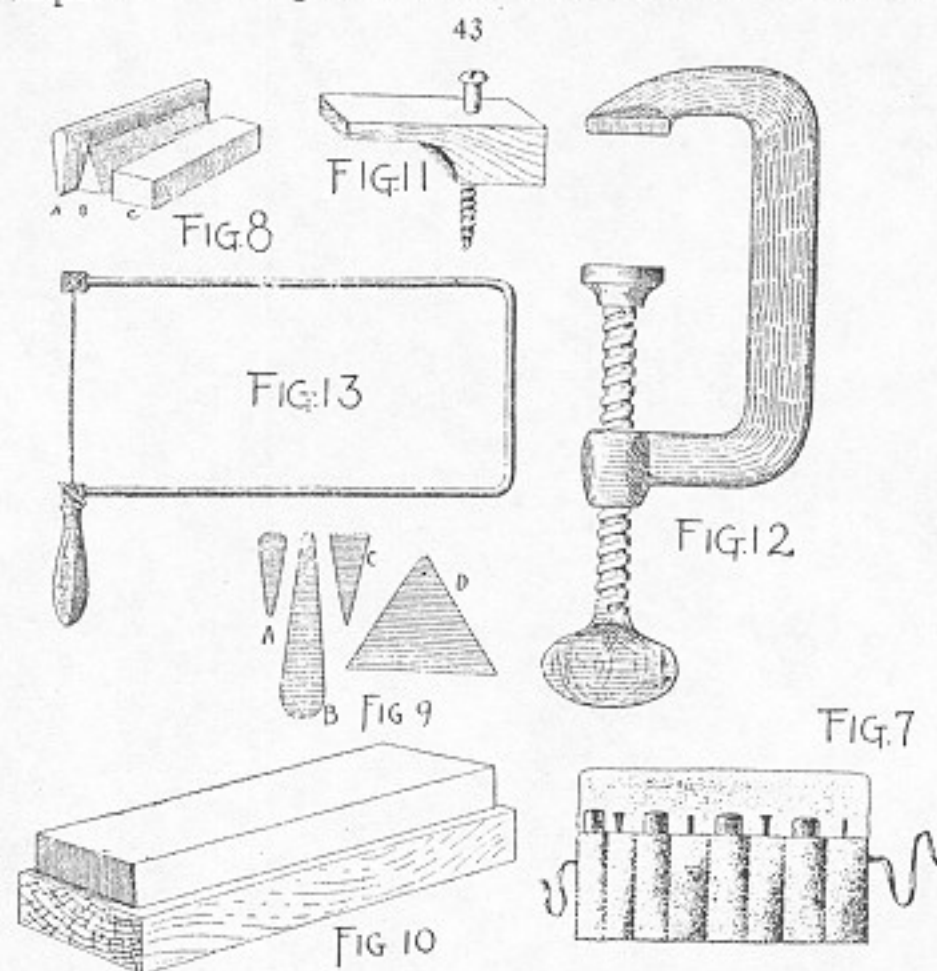
If the tools should be unusually dull they must first be ground on a grindstone, and as carvers' tools are sharpened

on both sides, they must be ground on both sides. The firmers may be sharpened on the oil-stone laid flat on the bench, but the gouges must be held in the hand, in order to sharpen the inside curve with a slip. The outer curve can be sharpened on the flat oil-stone, or held in the hand and dressed with the flat side of a slip. Great care must be taken to give the tools a finished and smooth edge. When they have reached the proper degree of sharpness it will be an easy matter to cut across the grain of white pine, leaving a furrow that is entirely smooth and almost polished.

In the use of the oil-stone and slips, neat's-foot oil, or a good, thin machine oil, should be employed. Astral oil is too thin, but the oil sold in small bottles for sewing-machines or bicycles will answer every purpose. Water should not be used, as it would spoil the stones, and not produce the sharp edge on the tools.

The finest stones are the best for use, and although they take longer to give the keen edge required, they will be found the most satisfactory in the end. Avoid grit and dust on the stones, and before using them they should be wiped off with an oiled rag. The beginner must not consider any pains too great to make himself thorough master of the tools, and to keep a perfect edge on all of them.

The tools being in proper condition, the next step is to acquire a knowledge of the best methods of handling them.



It will require some time and practice to become thoroughly familiar with the manner in which tools are used, and, if it is possible, it would be well to watch some carver at work.

The chisels should always be held with one hand on the handle, with two fingers of the other hand near the edge of the tool. This is to give sufficient pressure at the end to keep it down to the wood, while the hand on the handle

gives the necessary push to make the tool cut.

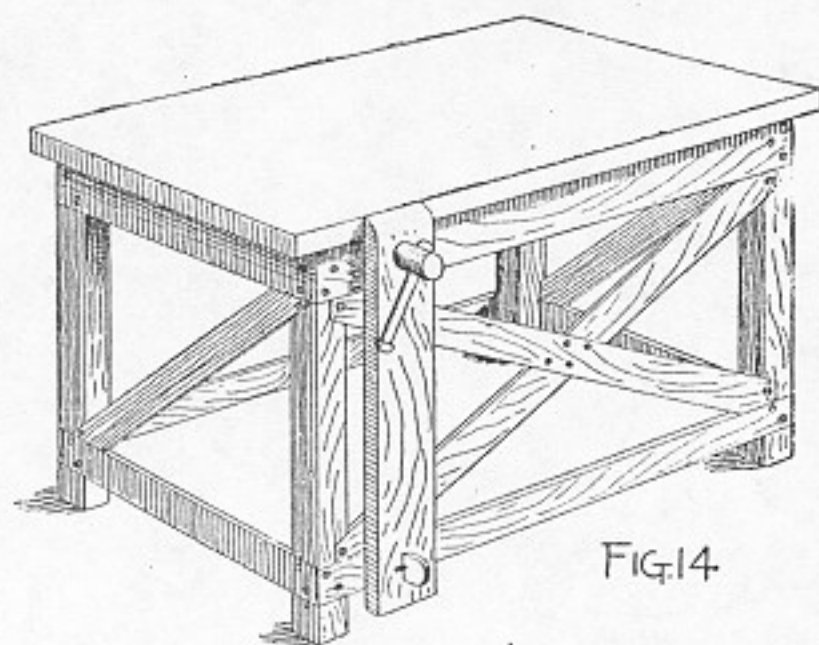
A Carver's Bench

A carver's bench is a necessity for the young craftsman, but if it is not possible to get one, a heavy, wooden-top kitchen table will answer almost as well. The proper kind of a bench gives greater facility for working, since it is more solid and the height is better than that of an ordinary table. Any boy who is handy with tools can make a bench in a short time of pine or white wood, the top being of hard-wood. If the joiner-work is not too difficult to carry out, it would be better to make the legs and braces of hard-wood also, to lend weight and solidity to the table.

The wood should be free from knots and sappy places, and as heavy as it is possible to get it, so as to make a really substantial bench. The top should measure four feet long and thirty inches wide, and not less than one inch and a half in thickness. The framework must be well made, and the corner-posts and braces securely fastened with lap-joints, glue, and screws. The top of the bench should be thirty-nine inches high, and to one side of the bench a car-

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penter's vise may be attached, as shown in Fig. 14. The jaw of the vise is seven inches wide, one and an eighth inches thick, and thirty-four inches long. It is hung as described



for the carpenter's bench (see Carpentry, Chapter I.). A wood or steel screw may be purchased at a hardware store, and set near the top and into the solid apron side-rail. The posts are four inches thick, and the cross-pieces and rails should be of seven-eighth-inch hard-wood four inches wide. The top overhangs the framework two inches all around, thus forming a ledge, to which the plates of wood or panels may be bound with the clamps and bench-screws. Where a clamp cannot be used, a cleat, as shown in Fig. 11, is screwed fast to the top of the table, and the projecting ear catches the edge of the wood and holds it securely.

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A coat of varnish or paint on the legs and braces will finish this bench nicely, and it will then be ready for the young workman's use.

Chip-carving

To begin with, it is best to work on a simple pattern that can be followed easily.

Get a piece of yellow pine, white-wood, or cypress seven-eighths of an inch thick, six inches wide, and twelve inches long. On a piece of smooth paper draw one-half of a pattern similar to the one shown in Fig. 15 A; or you may use any other simple design that is free in line and open in the

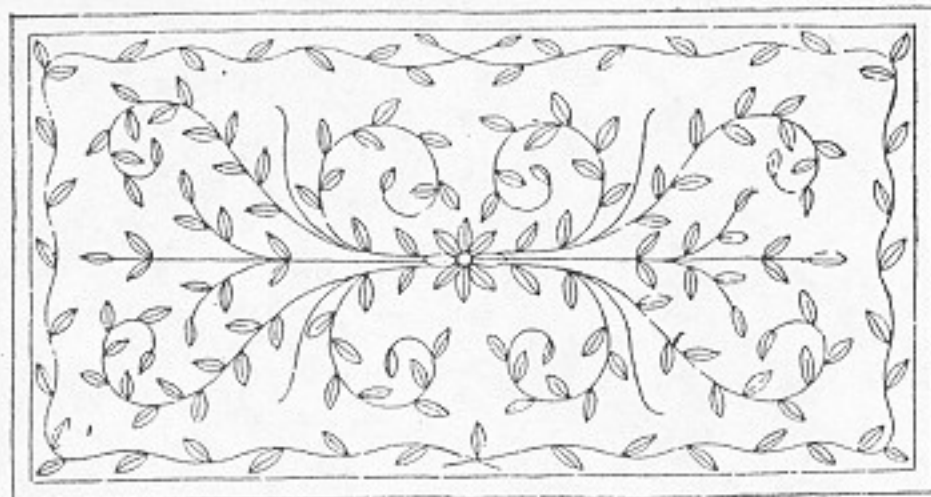


Fig. 15 A

ornament. Upon the wood lay a sheet of transfer-paper, with the black surface down, and on top of the transfer-sheet the paper bearing the design. Go over all the lines with a hard lead-pencil, bearing down firmly on the point,

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so that the lines will be transferred to the wood. Turn the design around and repeat the drawing, so that the wood will bear the complete pattern. Clamp the wood to one side or corner of the bench with three or four clamps. Do not screw the clamps directly on the wood, but place between the jaw and the wood a piece of heavy card-board, or another piece of thin wood, to prevent the clamps from bruising the surface of the panel.

First, with a small V, or gouge-chisel, cut the lines; after that the leaves, using a flat, or spade, chisel. Two curved incisions will shape out the leaf, and the angle through the centre describes the main vein. The chipping may be shallow or deep, as a matter of choice, but more effect may be had by cutting fairly deep.

The finished result will appear as shown in the illustration.

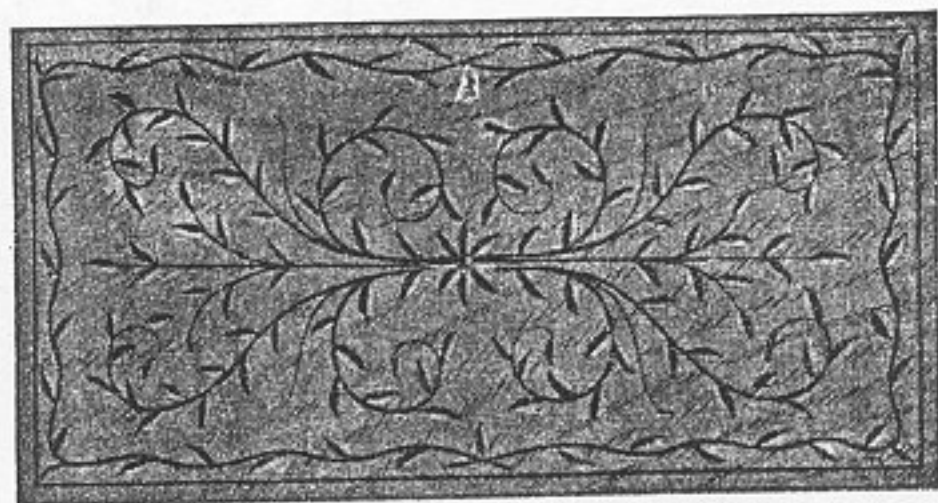


Fig. 15 B

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tion of the chip-carved panel (Fig. 15 B). For light ornamenting or drawer-panels, fancy boxes, and picture-frames, this form of carving may be made both pleasing and effective. Moreover, its mastery leads naturally to the more artistic relief-carving.

A Frame for a Small Clock

Get one of the little nickel-plated clocks (sold at sixty cents and upwards). Lay it down on a smooth piece of soft wood—pine or cedar—about seven by eight inches.



Fig. 16



Fig. 17

Mark around it closely with a lead-pencil, and cut out the circular opening with your knife. If you happen to have a fret-saw or suitable tools, you can make it of hard-wood. Smooth nicely with sand-paper. The clock must fit closely into the opening. You will find Fig. 16 very easy to do. Cut out the lines, being careful not to let the tool slip

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when cutting with the grain. Dilute the walnut stain with turpentine, and paint the design inside the lines; the grooves prevent the color spreading. Let it dry. The next day, with a wad of cotton or piece of canton flannel, rub on some varnish. Soft wood absorbs it very rapidly at first until the pores are filled. When quite dry, sand-paper nicely. Then rub again with varnish, a little at a time. Keep raw linseed-oil near you in a cup; dip one finger of your left hand in this when the work becomes sticky, and apply to the pad; it helps to spread the varnish. Rub briskly with a circular motion. The varnish will dry quickly, when it must have a final polish; this brings out the beauty of the grain. If carefully done, your work will resemble inlaying.

Some Other Designs

The daisy design (Fig. 17) is charming when finished, and has the additional merit of being easy. Cut the daisy form from a visiting-card, and mark around it. Stain the centre much darker than the petals.

Table-tops, jewel-boxes, calendar frames, chairs, etc., may be purchased already polished, and outlined in some dainty pattern. A finer tool (No. 11, $\frac{1}{8}$ ") comes for this

kind of work. Of course it cannot be stained, but if desired the background may be stamped with a star-pointed "marker" to give the design prominence.

These patterns may be adapted for the decoration of glove-boxes, bread-plates, knife-boxes, stools, blotting-books, card-cases, match-boxes, music-portfolios, and many

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other things, which will sell well at fancy fairs, or be highly appreciated as presents.

Relief-carving

Relief-carving differs from the chip work in that the ornament is raised instead of being cut in. Solid relief-carving, such as appears on panels, box-covers, and furniture, is produced either by cutting the background away or by carving the ornament separately and then gluing it onto the surface of the article to be decorated. Of course, this latter process is only a makeshift, and the first method is the really artistic one.

It is best to begin with something simple and then go on to the more complicated forms of ornamental work. A neat pattern for a long panel is shown in Fig. 18 A. This panel is twelve inches long and four and a half inches wide.

On a smooth piece of paper draw one-half of the design and transfer it to the wood, as described for the chip-carved panel. Clamp the wood to a corner of the bench and, with



Fig. 18 A

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a small wooden mallet and both firmer and gouge-chisels, cut down on the lines and into the face of the wood. Then, with the gouges and grounding-tool, cut away the background to a depth of one-eighth of an inch or more, until a result is obtained similar to that shown in Fig. 18 B. The entire design and edge of the panel will then be in relief, but its surface will be flat and consequently devoid of artistic feeling. With the flat and extra flat gouge-chisels begin to carve some life into the ornament. A little practice



Fig. 18 B

will soon enable the young craftsman to observe which parts should be high and which should be low. The intermediate surfaces should be left neutral, or between high and low relief. This finishing process depends for its effect upon the good taste and feeling of the craftsman; it is the quality that gives artistic beauty and meaning to the work. The panel, when completed, should have the appearance shown in Fig. 18 C.

As already stated, the general effect of relief-carving may be also obtained through the "applied" method, a simpler

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and less tedious process, but neither so artistic nor so substantial.

The design is transferred to a thin piece of wood and cut



Fig. 18 C

out with a fret or jig saw. Fig. 19 A shows a suitable pattern for this class of work. The pieces are then glued in position on a thick piece of wood, and the "feeling" carved



Fig. 19 A

in after the fashion already indicated. This "applied" carving may be used on the panels of small drawers, cabinets, and boxes of various sizes and shapes. The inventive

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Fig. 19 B

boy will be able to design patterns for himself, or they may be cheaply bought. Fig. 19 B shows the effect of the finished work.

Mouldings

In Fig. 20 some designs are given for carved mouldings,

and at the side, end views are shown.

Plain mouldings of various shapes may also be bought at a mill, or from a carpenter, and may be given "life" with a little care and work. Both hard and soft wood mouldings are available, but at first the softer woods will be found the easier to work.

A plain corner on a wooden picture-frame may be built up with blocks of wood glued on as shown in Fig. 21 A. When carved this piece will have the appearance of the finished corner shown in Fig. 21 B. The arms of chairs, corners of furniture, and the like may be treated in this same manner.

When flat and relief carving have been mastered, it would be well to attempt something in figure and free-hand work, such as animals, fruit, or heads. But it will take a good

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deal of practice on the simple and conventional forms before the amateur will feel himself competent for the more advanced art. As improvement in the flat work is noticed, the ornament may be "undercut" to give it richness and boldness.

To finish wood in any desired color, stains may be pur-

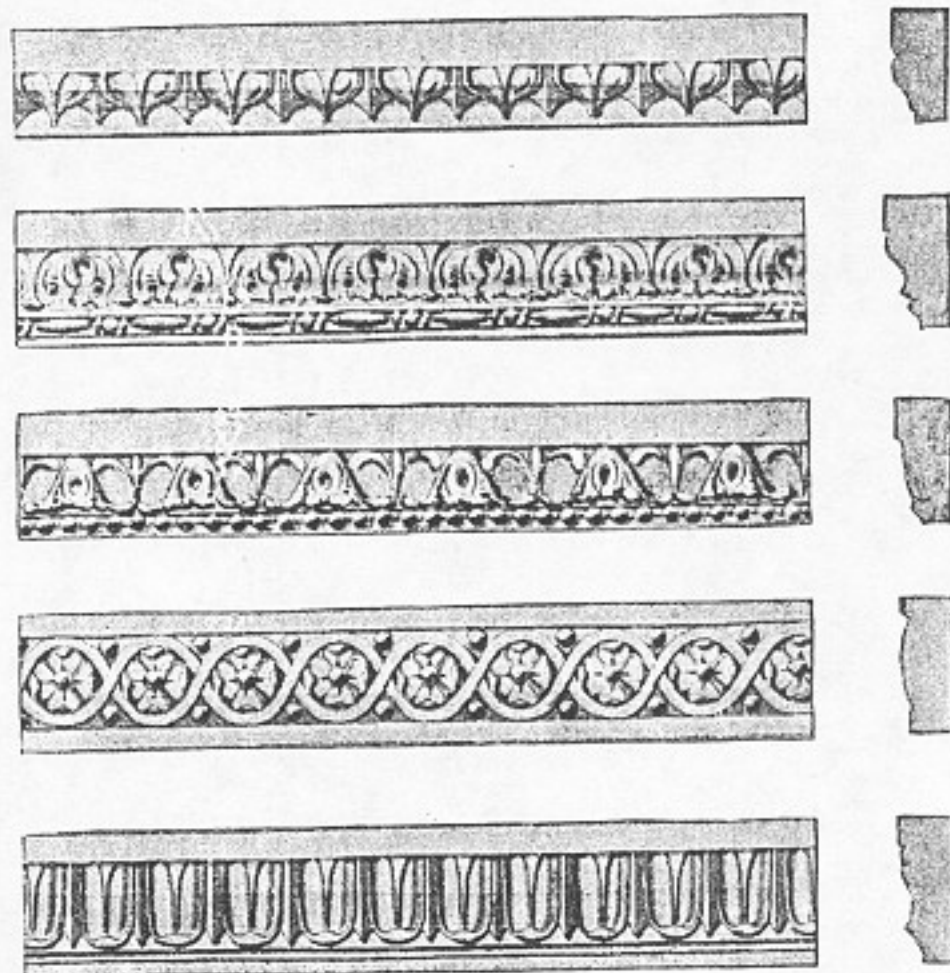


Fig. 20

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chased at a paint or hardware shop. Over the stained surface, when dry, several thin coats of hard-oil finish or furniture varnish should be applied. The back and edges of a carved panel must always be painted to protect them from moisture and dampness; warping and splitting are thereby avoided. Some pieces of carving need only a coating of raw linseed-oil, while others may be treated to a wax finish composed of beeswax cut in turpentine, rubbed in with a cloth, and polished off. Another method of darkening oak (before it is varnished) is to expose it to the fumes of am-

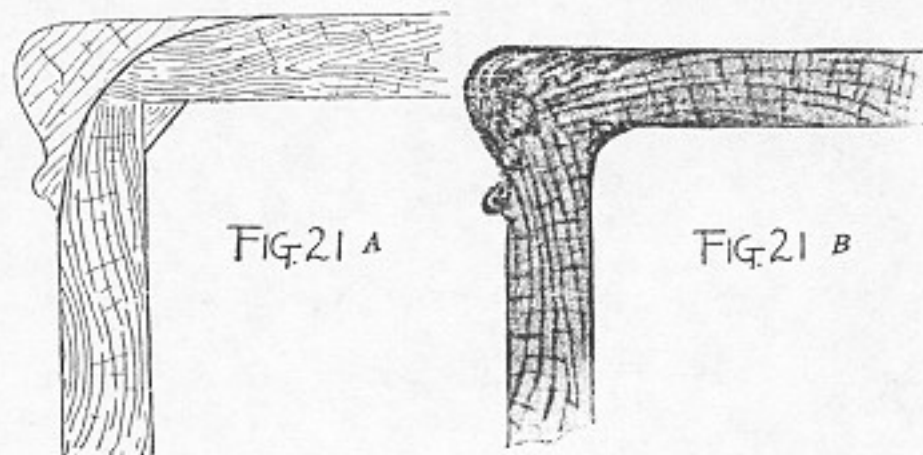


FIG. 21 A

FIG. 21 B

monia, or to paint on liquid ammonia, with a brush, until the desired antique shade is obtained. The staining process, however, is preferable.

Chapter III

FRETWORK AND WOOD-TURNING

NEARLY every boy has had, at one time or another, a desire to make scroll-brackets, fretwork-boxes, and filigree wood-work of various sorts. The art is naturally affiliated with other decorative processes in wood-working, such as wood-turning, carving, and marquetry, or the art of inlaying woods. Both fretwork and wood-turning are very old crafts, and were practised by the ancient Egyptians, specimens of their work being still extant.

A great deal of amusement and pleasure may be had in the possession of a scroll-saw, or "bracket machine," as it was commonly known among boys some years ago. And first, as to the implements required.

The Tools

To those who can go to the dealer and pay for just what their fancy dictates, there is no trouble to procure all the tools that may be needed for the finest work; but others who cannot afford this luxury may get along nicely with a very small outlay. In fact, in nearly every instance known to the writer where the amateur has really rigged up his

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own machine, he has become master of the art sooner. A number of years ago the writer, then a school-boy, transformed an old sewing-machine table into a scroll-saw and lathe, and to-day this homely old stand and crudely put together machine does as good work, with as little effort, as the finest and most expensive outfit. This machine, all complete, with the drilling attachment, cost: old machine, one dollar; dozen saws, assorted, twenty-five cents; new material, rivets, etc., sixty-five cents; drills (still in use), fifteen cents; total, two dollars and five cents.

This money was saved from building fires and taking up ashes, and the first time the saw was run—one cold, stormy day in late November—there was cut up material which, when put together and sold (playmates and school-fellows being the customers), amounted to over three dollars in cash, besides a few pocket-knives, bits of rare wood, and the like that were taken in exchange.

Making a fine scroll-saw from a sewing-machine is of itself an easy matter. The balance-wheels should be retained, in order that all back lash can be easily overcome. The two arms holding the saw are to be geared from some wheel in the rear or connected with a belt. If the wrist-pin (the crank, or pitman wrist) gives too long a motion, it can be easily taken up by either drilling another hole nearer the centre or using a bent crank-pin. In any event the cut should not be over one inch.

Another method of shortening the stroke (and a very good one if the means of making the other changes are not at hand) is by changing the bearing of the arm. The nearer the saw the shorter the stroke. The clamp-screws holding

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the saws should be adjustable, so that either a long or a short saw-blade may be used. Those who break their blades (and there are none who do not) will find great economy in using adjustable clamps, as the short pieces can be used for sawing thin stuff, veneers, and the like. The best kind of clamp is provided with a slit to receive the blade and a set-screw for tightening.

The tools necessary for hand-sawing are very simple and inexpensive, consisting of a wooden saw-frame, one dollar; dozen saw-blades, twenty cents; one clamp-screw, twenty-five cents; drill and stock, fifty cents; total, one dollar and ninety-five cents.

In selecting saw-blades be careful to buy only those with sharp and regular-cut teeth. Saws are graded by number for hand-sawing. Numbers 0 and 1 are the best sizes, unless for very delicate work, when finer ones should be used. The larger blades have coarse teeth, which are liable to catch in the work and tear it. Since, at the best, the motion of the hand-saw is jerky, not nearly so nice work can be done as with the treadle-saw, which has an even, steady gait.

For all open-work it is necessary to have something to punch holes, so that a start may be made on the inside. Many use an ordinary brad-awl, but this is liable to split the wood. Besides, it is not possible to punch a hole so smooth and nice as it can be drilled or bored; hence, a drill is included in the list, and it will be found a very handy tool for either hand or treadle saws. The most serviceable article of this kind is the small German drill-stock, that can be bought with six drill-points, assorted sizes, for fifty

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cents, or the small hand-drills, with side wheel and handle, and provided with a small chuck to clutch the drill.

From what I have said, it should not be inferred that any objections are made to any of the beautiful little machines now to be bought at moderate cost. By all means, when the expense can be afforded, these should be used. The good ones will do the most delicate work, can be run with great ease, and will cut from eight to twenty pieces at a time, according to the thickness of the wood, leaving the edges of the work perfectly smooth. In using treadle-machines, insert the saw-blades with the teeth pointing downward and towards the front of the machine, and guide

the wood easily with the fingers, with the wrists resting firmly on the table, being careful not to feed too fast or crowd against the saw sideways. Otherwise the blades will be heated and broken, and they will wear away the little wooden button set at the centre of the plate to prevent the saw from touching the metal work-table.

The Practice of the Art

Most boys know how to run a scroll-saw, or think they do, yet a few practical hints should not come amiss.

To begin with, the machine should be well oiled, all nuts, screws, and bolts turned up tight, and the belts adjusted at sufficient tension to run at a high rate of speed without slipping. Many machines, even in large mills, are groaning and filing out their journals and bearings simply because the belts are too tight. One of the first principles to be mastered in applied mechanics is that of power trans-

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mission, and right here the young workman has the best of opportunities to solve, in a measure, a great mechanical problem—namely, a belt tight enough to drive the machine and do the work, and loose enough to run easy and cause no unnecessary friction or wear on the journals and boxings.

For your first practice take some cigar-box wood (of which a good stock should be kept), and trace upon the dark sides a series of angles and curved lines. Never, under any circumstances, begin sawing without a tracing, or a pattern of some kind, to saw to, for now is the time to cultivate habits of accuracy. With no design or objective-point, nothing but a bit of useless board will result; besides, you will form a habit of working without a guide, a habit that has made more poor artisans than the love of idleness and bad company. Lay the wood on the rest, or plate, and see that it lies solidly. If it shakes, the wood is uneven and should be straightened, for no one can saw a warped board and make accurate work; besides, it is impossible to work in such wood without breaking the saws. The wood being level, hold it down with the left hand, fasten securely a No. 1 blade in the frame, and begin sawing, being careful to keep the motion very high and feeding slowly, sawing out the tracing lines, or keeping close to one side of them. If an ordinary hand-frame is used, work it firmly in one direction, keeping the blade perpendicular, and turning the wood so that the saw may follow the pattern.

After you have thoroughly learned the motion of the machine, the cutting of the saw, feeding, etc., try sawing a straight line, being careful not to push or crowd the blade sideways, as this will not only make the lines crooked, but

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will heat and ruin the blades, if it does not break them. When you have become an adept in following a straight line, and cutting the lines of a curve accurately, mark out several Vs and squares. To saw a V begin at the upper end and saw down to the point; now back the saw out, and saw from the other end down to the same point. If the line is carefully followed, this will insure a sharp, clean-

cut angle. To cut out a square hole, saw down to the angle, then work the blade up and down in one place rapidly until it becomes loose; then turn the wood at right angles and saw carefully along the line to the other corner, when the operation may be repeated. Just as soon as you can saw straight and curved lines true to tracings, it is safe to begin good work with little if any fear of spoiling lumber or breaking an undue number of saws.

The Preparation of the Work

One of the simplest objects for a beginner to try his skill upon is a wall-bracket such as shown in Fig. 1. A piece of cedar—the bottom and lid of a cigar-box will answer the purpose excellently—from seven to eight inches in length by six and a half in width is a convenient size. The shelf is a semicircular piece either plain or scalloped in front, and its support must be of light, open, but strong design to match one-half of the lower design to the wall-plate. Hinges are sometimes placed to all parts in order to make it easy to pack the bracket. But such additions can only be made by the expert craftsman.

The first thing to be done is to trace the design on a thin

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piece of paper after it has been drawn roughly on a smooth sheet of brown paper. When the tracing is complete, lay it face downward, and cover it with powdered red chalk. The tracing is then imposed on the wood, with the red side downward. With a blunt bodkin or lead-pencil we now draw firmly along the lines, thus reproducing the tracing on the surface of the wood. Having accomplished this, we remove the paper, and with pen and ink make a complete drawing of the outlined design on the wood.

In designing fretwork great care must be taken to get the two sides of the pattern alike and in correct drawing. This can best be done by drawing the design on tracing-paper, and doubling it over when, with a little extra pressure of the pencil, a good design can be obtained on both sides of the paper.

When this has been accomplished pierce the wood at various points with a drill. The holes thus made are to allow the saw to enter. The wood may now be put in the clamp. Then with a moderately strong saw the young beginner can make his first attempt. The frame must be held perfectly straight and the arm worked steadily up and down.

Turning the saw is always a difficult point with amateurs, but in reality there is but little in the operation that cannot be mastered with a few moments' practice. The secret of turning neatly and without damaging either saw or wood is to work very steadily up and down, but not forward, when the turning-point has been reached. Then by a sharp and active movement of the wrist and wood the saw should be turned, but not jerked, and the new line

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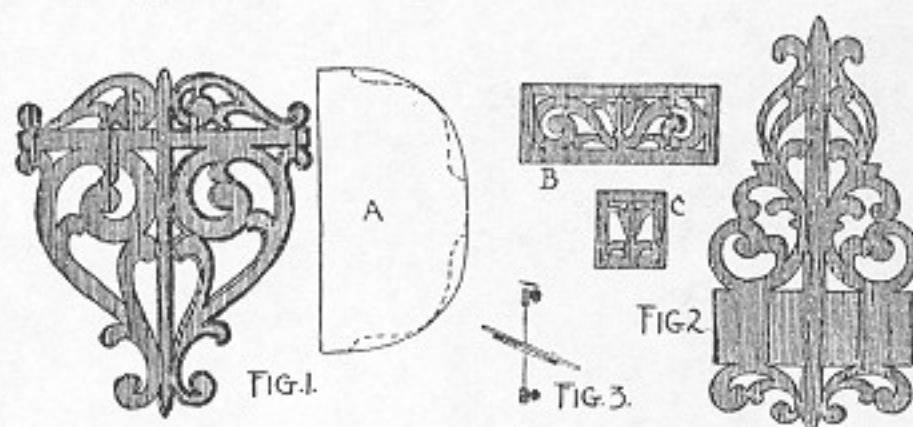
commenced. Sometimes, however, the delicacy of the pattern makes this impossible. The saw should then be pulled

backward and forward gently until a sufficiently large hole has been made.

It is impossible, within the limits of this chapter, to give designs for any considerable number of the articles that can be made in fretwork; but with the descriptions just given, and the few accompanying patterns, a boy who has any idea of drawing and designing can put parts of an ornament together and so work out new and attractive variations.

A Match-safe

The design for a match-safe is shown in Fig. 2, the wall-plate measuring two inches and a half in width and seven inches high. One side of the pattern should first be drawn



in free-hand, then traced and transferred to the thin wood and the lines gone over with a sharp-pointed, hard pencil, so that it will be an easy matter to see them when sawing.

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The front plate of the match-safe is shown at B and one end at C. The front is two and a half inches long and one inch wide, and the ends are made in proportion, or about seven-eighths of an inch wide. These parts are put together with slim steel nails and glue, having first drilled the holes where the nails are to be driven to prevent them from splitting the wood.

Most of the modern scroll-sawing machines have movable beds, so that bevel cuts can be made. This is done by tilting the bed or table slightly, as shown in Fig. 3. As a result the work will have a narrower face than the back, as shown at the right side of the bracket in Fig. 1. However, in making the front, or bracket part, there should not be any bevel-cutting, since it would look one-sided. Keep the bed flat in that case, and make the regular cuts for straight work.

A Wall-bracket

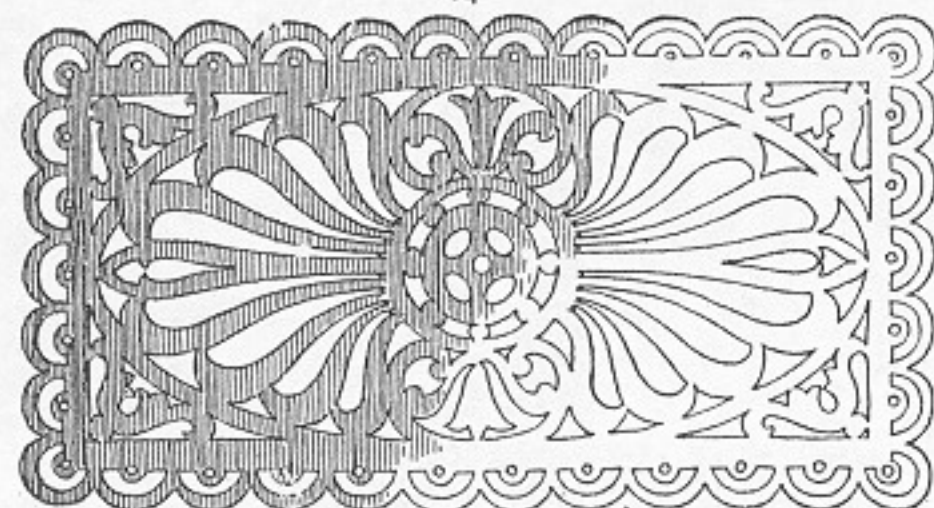
The simple bracket shown in Fig. 1 is an easy one to draw, and it may be cut from holly, birch, oak, or any good wood about one-eighth of an inch in thickness. The bracket or front-piece is half the back-plate, omitting the top ornament. The shelf (A) may be rounded, scalloped, or cut serpentine, as indicated by the dotted lines, and the three parts are put together with fine nails, or screws, and glue.

A Fretwork-box

For a glove or necktie box an attractive design is shown

in Fig. 4, A being the top and B the front or back. The ends should be made a proportionate size, and a part of the

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A



B

FIG. 4.

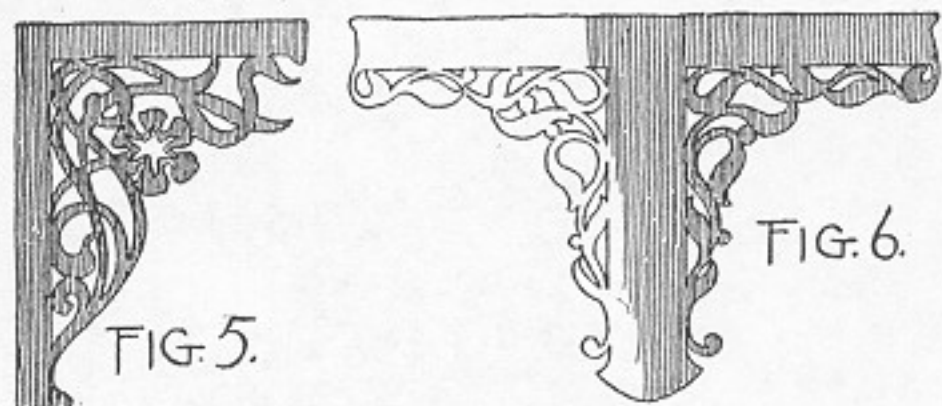


FIG. 5.

FIG. 6.

A GLOVE-BOX AND A T BRACKET

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traced ornament can be transferred to them, so as to match the other parts.

A good size to make this box will be ten inches long, five inches wide, and three inches deep. This should be the size of the main rib or rectangle in the top, and out from it the scallops project three-quarters of an inch all around.

Lay out one-quarter of the cover design on a piece of smooth paper; then make a tracing of it. With a piece of transfer-paper this quarter should be gone over with a blunt lead-pencil, so that the lines will be transferred to the wood. Take care when making a transfer to see that the quarter has been accurately placed on the wood so that a perfect rectangle will be had.

Put this box together with glue and small, slim nails, and arrange a bottom of thin wood to fit where the lower cross-rib of the sides is shown. If the saw leaves ragged edges at the reverse side of the wood, they may be cleaned off with fine sand-paper or a small file.

Some Other Designs

Another design for a bracket is illustrated in Fig. 5; and in Fig. 6 a T is shown that may be used for a bracket or a

wall-hanger, along the top edge of which small hooks may be arranged to hold a shoe-horn, button-hooks, scissors, and other small bedroom accessories.

Wood-turning

The common examples of wood-turning with which a boy is most familiar are tops, balls, bats, dumb-bells, Indian

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clubs, broom-handles, and spools. All of these objects are made in a lathe, and this is the self-same machine that has been in use for centuries, with but few modifications. Like the potter's wheel, it is simplicity itself and needs no improvement.

The object of a lathe is to cause a piece of wood or other material to revolve from end to end, so that when a chisel or other sharp-edged tool is held against the moving surface it will cut away that part of the material at which the tool is directed.

The boy who lives near a wood-working establishment, or mill, can gain more knowledge in watching a wood-turner at work for half an hour than he can learn from reading a book on the subject for many days. It is a simple craft, but a firm hand and a true cut are the important factors in making a boy a master of the lathe.

Once the knowledge is gained, however, it is an easy matter to turn all sorts of objects.

A simple lathe may be made from a small table, a grindstone, a trunk-strap, and several small parts that are easily gotten together. Read how in his boyhood days the author constructed a small lathe.

Between the legs of a table two bars were nailed across for supports to the shaft, which was made of oak and measured three feet long and one inch square. This just fitted the hole in a grindstone that was used for the balance-wheel. Six inches from the ends of the shaft the corners were cut away to form bearings on the cross-bars, which were hollowed out to receive it. A leather strap was nailed over to keep it in position. The grindstone was next placed

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on the shaft, near one end, between the bearings, and wedged. Over it two brackets, four inches high, were screwed in position on the table top, six inches apart, forming a support for a shaft of a small wheel or pulley made of wood. In the end of an ash shaft, one inch square and eight inches long, were three sharp points made by driving in nails without heads, the projecting ends being filed to points; these, forced against the block, held one end firmly enough to turn. The places where the bearings came were cut in the form of a cylinder three-quarters of an inch in diameter, and corresponding places were hollowed in the supports (as shown at Fig. 8) to receive it, a small piece of wood being screwed on over each, after the shaft and wheel were put in position.

A belt was made of an old trunk-strap, passed round the grindstone and through two holes in the table over the little wheel, causing the latter to revolve very rapidly when the former was turned. This was done by a treadle put

in the following manner: Two cranks were made (A in Fig. 7) by a blacksmith and attached to the ends of the long shaft. They were three inches long and had a knob on the end of the handle to prevent the connecting-rods from slipping off. The latter were of hard-wood, with a half-inch hole bored through near one end. They were then split six inches, allowing them to be placed on the handles. A screw was then put in to secure them, the lower ends being connected with a treadle made as in Fig. 7.

The second spindle at first was made immovable by inserting a piece of quarter-inch wire in a wooden bracket, which was screwed to the table; but finding it not always

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convenient to use blocks of the same length, one was arranged to slide; it could be secured in any position with thumb-screws. A long cut a quarter of an inch wide was first sawed in the table in the line of the short shaft; then

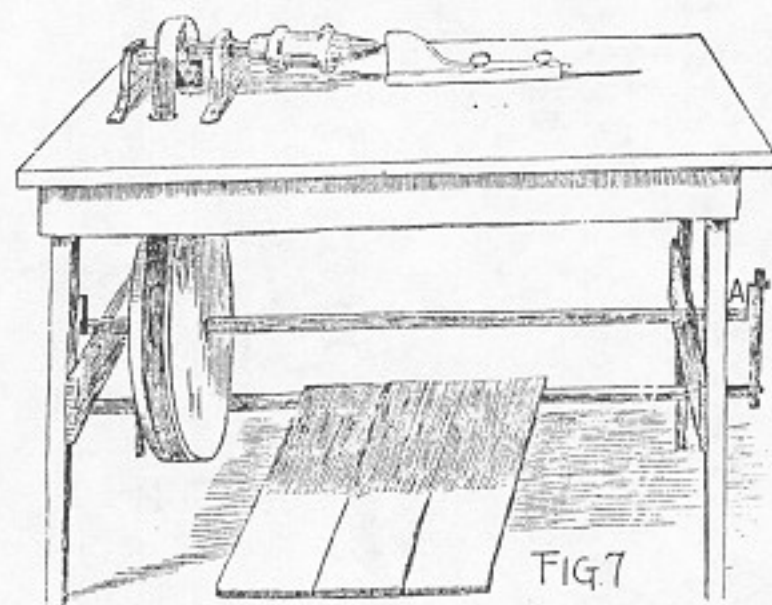


FIG. 7

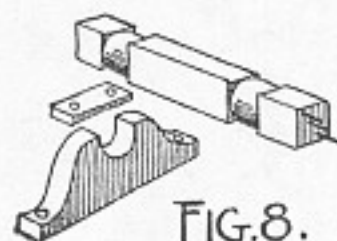


FIG. 8.

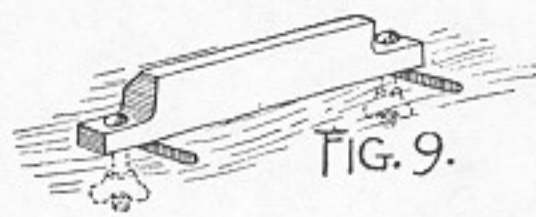


FIG. 9.

a bracket three inches high was screwed to a short strip two inches wide, one inch thick, and a foot long. A similar strip was placed beneath, through which two thumb-screws passed. A piece of wire, filed to a point and driven in

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the bracket, served for a centre. A movable block of wood three and a half inches high was used for a tool rest, which by means of two small bolts and thumb-screws was held fast to the table top. Slots cut in the table top made it possible to move this rest forward or backward, and the thumb-screws, or winged-nuts, as they are properly called, were tightened at the under side of the table, as shown at Fig. 9.

A great deal of pleasure may be had at little or no cost with a lathe of this description. All sorts of small things may be turned, and when a boy has mastered the craft it would be well to add an iron lathe to his stock of tools, if the cost is at all within his means.

Chapter IV

PICTURE MOUNTING AND FRAMING

THE modern idea in framing pictures is to have the frame harmonize with the subject, rather than to employ a stock moulding with set pattern made by the mile, and cut up into frames of all sizes and for all sorts of pictures. All the frames shown in the illustrations accompanying this chapter were made at home, and from such simple materials as thin boards, burlap, tea-chest matting, denim, wire, sheet-lead, harness-rings, and brass-headed upholsterers' tacks.

A Dutch Head Mounting

For the study of a Dutch head a unique frame, or mounting, is shown in Fig. 1. This is a board of thin wood of a size in proportion to the photograph, the latter being nailed to the board with large, oval-headed tacks painted black.

The board is covered with green denim, the edges of which are drawn over the back of the board and glued, or fastened with small tacks. The photograph, a platinum print, is trimmed to an oval, and then mounted on a white card. When the paste is dry the mount is also cut ovalwise, fol-

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lowing the line of the photograph, and leaving a white margin half an inch in width. The picture is placed on the board so that the side and top margins will be equal; it



Fig. 1



Fig. 3

is then fastened in place with upholsterers' tacks driven three-quarters of an inch apart.

These nails, as well as the other metal-work, are to be coated with a mixture of dry lampblack and shellac before they are driven on the board. The nails should be painted some time before they are to be used, so that the black coating will be thoroughly dry. After the nails are driven

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in place it may be necessary to go over them with a small brush and some of the black paint, to touch up places where the coating has chipped off.

The ornament below the picture and the hanger-straps are cut from sheet-lead about one-sixteenth of an inch in thickness. The stems are of ordinary iron wire, such as may be purchased at a hardware store for a few cents. Each piece of the design is separate, and may be easily cut from soft lead with an old pair of shears, and afterwards trimmed with a pocket-knife or a small file.

Drawings of the metal parts to this frame are shown in Fig. 2. A is the strap at the top, where the hanger is attached; B, the scrolls forming the hanger; C, one of the buds at the top of the stem of wire; D, the flower at the middle of the frame under the picture; E, one of the long leaves; and F, a shorter curved one. These are all painted black before they are applied to the board; then they are caught with large and small nails, the large ones for effect, the small and invisible ones to securely attach the metal ornaments to the wood.

Small staples made from pins with the heads cut off are used to hold the wire stems in place, but at the outer ends the wire is caught under the buds or flowers, where it is held in place with an upholsterer's tack.

The ornamental hangers are made from thin strips of stove-pipe iron one-quarter of an inch wide, and may be shaped with a small pair of pliers or bent with the fingers. (See Chapter V., Venetian and Florentine Metal-work.) The long upper part of the strap-pieces are bent over and caught at the back of the frame, and form a sta-

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ple, into which the lower loop of each hanger is made fast.

If the large, oval-headed nails which hold the picture to the board cannot be had at your hardware store, imitation heads may be cut from lead, blackened, and fastened on with two or three fine steel-nails.

A Dark Card Mounting

The mounting shown in Fig. 3 is constructed along the same lines as that of Fig. 1, but the hangers are different, and the picture, having a white edge, is mounted on a dark card. The nails are then driven on the white band, in order to make them more conspicuous than they would be if fastened on the outer margin.

A line may be drawn on a piece of smooth brown paper indicating the size of the frame, and another one to denote the location of the picture. The design should then be drawn on the paper with lead-pencil, and the little flowers, buds, and leaves fitted to this plan. The wire may also be bent to conform to the lines of the drawing, so that it will be an easy matter to apply the accurately fitted parts to the frame, where they are fastened with small, oval-headed tacks.

A strip of sheet-lead five inches long and one-half an inch wide is cut V-shaped at the bottom, and the top is

bent over a two-inch harness-ring, then drawn down and fastened with a nail, to prevent it from releasing the ring. These hangers are fixed at the top, midway between the picture and the outer edge of the frame. Large-headed

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wrought-iron bellows-nails are used on which to hang the picture; they are driven into the wall, and, when necessary, the picture may be removed from them by simply lifting the rings over the nail-heads.

A Triple Mounting

The long panel effect shown in Fig. 4 is a simple and pleasing mounting for small photographs, or colored prints.

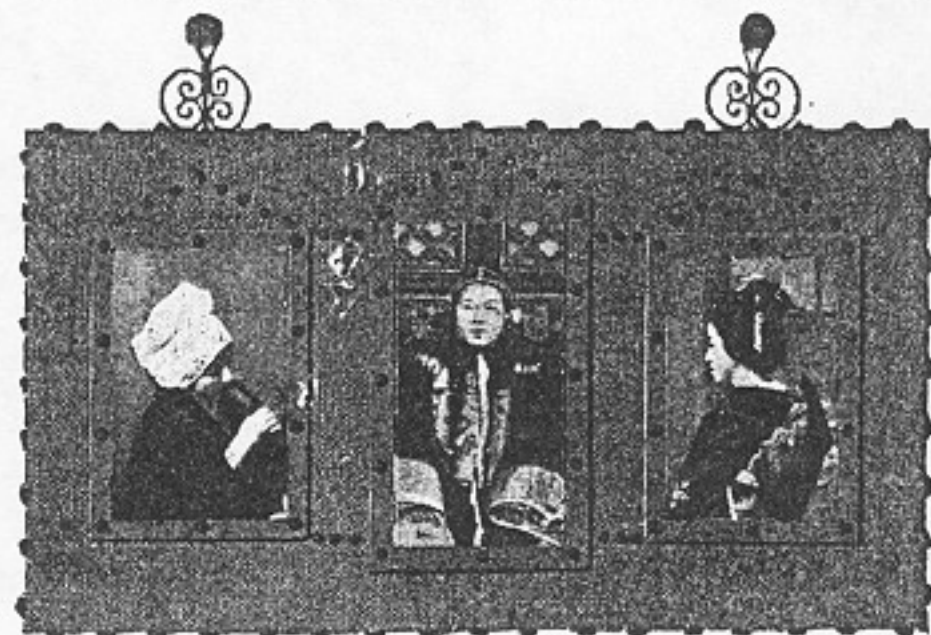


Fig. 4

A board is covered with ordinary burlap, which is drawn over the surface and tacked at the back; apparently it is held in place by the large, oval-headed tacks driven all around the outer edge. A card-mount the size of the

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photograph is cut away at the middle, leaving the outer edge about half or five-eighths of an inch in width. This is laid over the photograph, and through it the nails are driven which hold the photograph and the frame to the board. The scroll-hangers at the top and the nail-head decorations add to the artistic appearance of this frame.

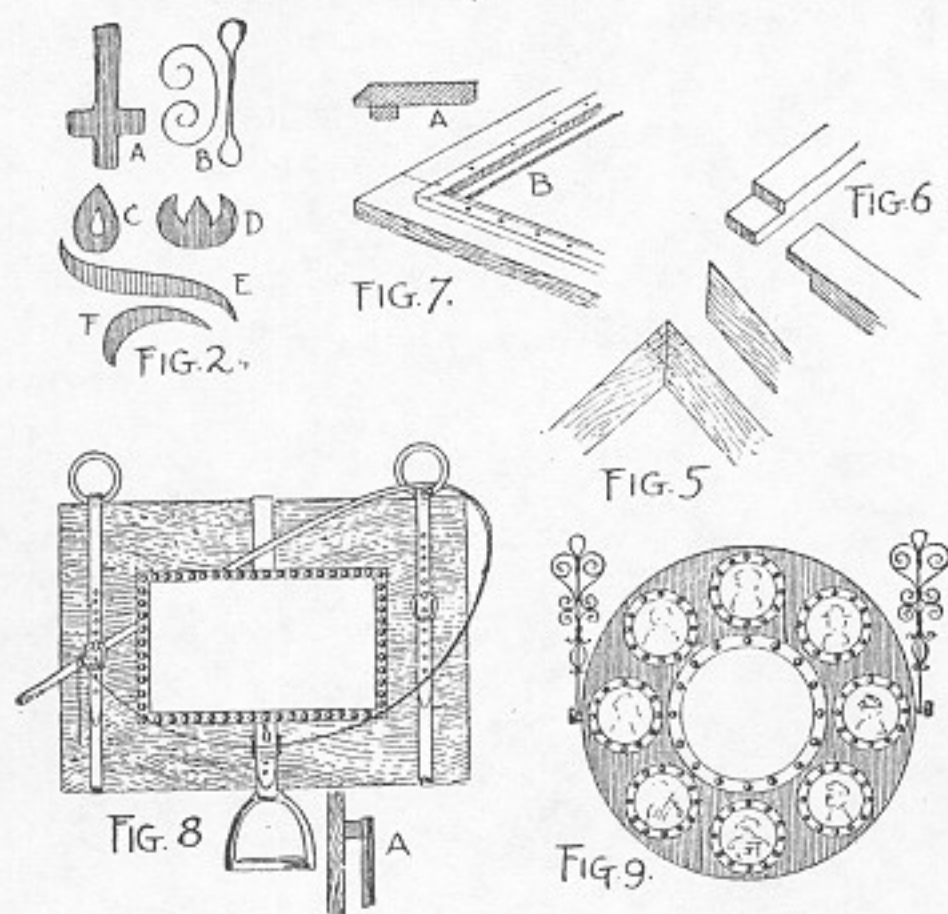
Plain Framing

For etchings, water-colors, or colored photographs and aquarelles, where a wide mat is desirable, plain narrow frames should be used. These may be made from moulding with the rabbet cut in by machine, but the boy craftsman may use flat rails and make his own rabbet.

First cut the joints with a mitre-box and saw; then with glue and slim nails a good union is made, as shown at Fig. 5, the dotted lines representing the long, slim nails. If a lap-point is preferred to a mitre, both ends of the flat rails should be cut away, as shown at Fig. 6, the union being made with glue and short screws driven in from the back of the frame, taking care, however, not to puncture or de-

face the face of the frame. Where a rabbet is to be made at the back of a frame, the front inner edge should be bevelled, as shown at A in Fig. 7, so that there will not be too great a thickness of wood close to the glass. A quarter of an inch out from the inner edge of the frame fasten four square sticks with glue and small nails. These sticks should be three-eighths of an inch square, and mitred at the corners, as shown at B in Fig. 7. The glass can then lie on the back of the frame within the space described by

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the small sticks, and over it the picture and back-board are placed, the nails being driven in to hold them in place.

A Sporting Mount

For a picture in which horses are prominent, such as a race, a group of horses' heads, or a driving scene, an appropriate frame is suggested in Fig. 8.

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The frame proper is made from narrow strips of wood, the face of which is studded with oval-headed nails. This frame is then arranged on a large board, and at the corners blocks, or separators, are fastened, which will cause the frame to stand away from the large board for half an inch or so, in order that the stirrup-strap and the whip-handle may pass under it, as shown at A in Fig. 8.

The frame is hung by means of large harness-rings caught at the top of the frame with leather straps. These are carried about the back-board and buckled at the front. The stirrup is suspended from the lower middle part of the frame on a strap, which is caught about the back-board and runs under the small front frame.

Dark Flemish oak for the back-board, russet straps, and brass buckles will make a pleasing combination; and if the picture is a colored one, it will add greatly to the effect of

the complete mounting.

A Round-robin Mounting

For one large head-picture and a number of small ones a novel scheme for mounting is shown at Fig. 9.

This is a one-piece barrel-head covered with burlap or denim. The photographs are cut circular and mounted on heavy white or cream-colored card-mounts, then trimmed so that a margin half an inch wide will be left all around. These are to be applied to the barrel-head with oval-headed upholsterers' nails, as suggested for Fig. 1. The hangers are made from thin strips of iron, and should be as long as half the diameter of the board.

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Part II

METAL-WORKING

Chapter V

VENETIAN AND FLORENTINE METAL-WORK

IN Italy, many years ago, there originated the pretty household art of making small objects from metal strips bent into graceful curves and scrolls, and then banded together. During the past few years American and English boys have taken up this Venetian and Florentine metal-work, and to-day the materials may be purchased at hardware stores in all the large cities.

The tools required are a pair of flat and a pair of round-nosed pliers, or pincers, a pair of heavy shears, and a pair of wire-cutters; a small bench-vise will also be useful.

The materials include a few sheets of thin stove-pipe iron of good quality (it may be purchased from a tinsmith), several yards of fine, soft iron wire, and some heavier wire for framework.

From the sheets of iron narrow strips are to be cut with the shears, and for ordinary work they should be not more than three-sixteenths of an inch in width; for heavier or lighter work the width may be varied. If it is possible to obtain the prepared strips at a hardware store, it will be better than making them at home, since it is a tiresome task to cut many of the strips from sheet-iron. Soft, thin iron

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that will bend easily is the only kind that is of use, as the hard or brittle iron breaks off and it is impossible to bend it into uniform or even scrolls.

A little patience and perseverance will be necessary at first until the knack of forming scrolls has been mastered, but once learned it will then be an easy matter to make many pretty and useful objects.

A Lamp-screen

An attractive design for a lamp-screen is shown in Fig. 1 A. When completed and backed with some pretty material it will be found a useful little affair to hang against

the shade of a lamp to shield one's eyes from the direct rays of a bright light.

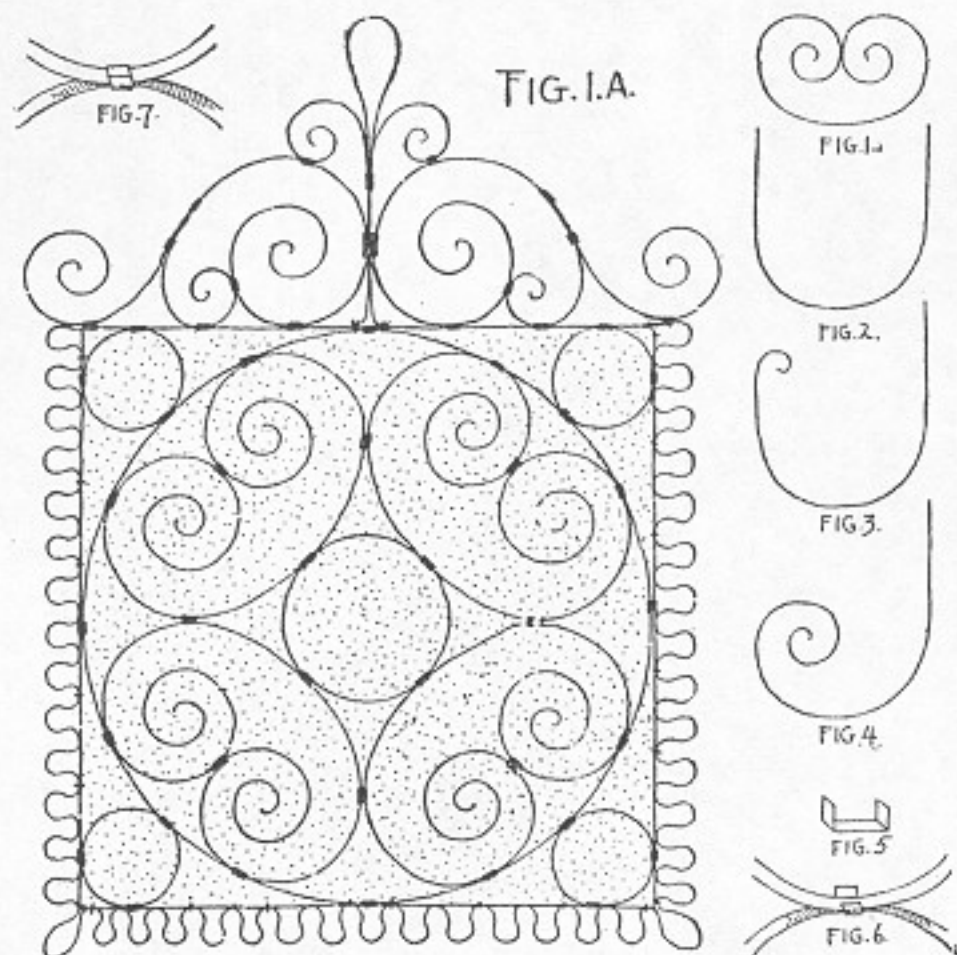
To begin with, form a square of six inches, and at the top where the ends meet make a lap-joint by allowing one end to project over the other; then bind them together with some very fine wire—about the size that florists use. Inside of this square make a circle six inches in diameter, and wire it fast to the square where the sides, bottom, and top touch it.

Bend four small circles, and fasten one in each of the four angular corners between the circle and square; then form the centre scrolls and the hoop in the middle of the screen.

To form a scroll like that shown in Fig. 1 bend a strip of metal in the form of a U, as shown in Fig. 2, and with the round-nosed pair of pliers begin to curl one end in, as shown in Fig. 3. When it has been rolled far enough in to form one side of the scroll, it will appear as shown in

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Fig. 4. By treating the other end in a similar manner the finished result will be a perfect scroll like Fig. 1. Four of these scrolls are to be made and banded to the circle and



to each other, and in the centre the hoop must be made fast with little metal bands.

When uniting or binding two strips of metal together they may be fastened with wire or bands, as a matter of

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choice. If the latter mode is employed, short pieces of the metal strips are to be cut and partially bent in the form of a clamp, as shown in Fig. 5. Bring the two sides together and bend one ear of the clamp over them (Fig. 6), and if the other ear is the proper length, bend that down in place, and squeeze all together with the flat-nosed pair of pincers. The perfect joint will then appear as shown in Fig. 7. When using metal clamps the ears should be of

such a length that, when pressed down over the united strips of metal, the ends will just come together and not overlap.

Having made the body part of the screen, form the scrolls of the top, and bind them in place with wire or the little metal clamps. This top should measure some three inches high from the top rib of the screen, and the end scrolls should project about three-quarters of an inch beyond the body of the screen at either side.

For the sides and bottom form a frill of metal and fasten it to the screen with wire; it should not be more than three-eighths or half an inch in width, and can be bent with the round-nosed pincers and the fingers. Better wear gloves for this part of the work.

When the metal-work is finished it will be necessary to coat it with black paint to improve its appearance and prevent its rusting. There are several good paints that may be used for this purpose, but if they are not easy to obtain an excellent coating may be made by dissolving a little shellac in alcohol and adding dry lampblack so it will be about the consistency of cream. It should be applied to the metal with a soft brush, and if it should become too thick it may be thinned by adding alcohol.

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Two thin coats will be all that are required for ordinary purposes, but if the metal-work is exposed to the weather, or any dampness that might cause it to rust, a coat of red lead should be applied next the iron. Red lead can be mixed with boiled linseed-oil to make a good metal paint.

A backing of some pretty, light-colored silk is required to complete the screen, using one, two, or three thicknesses to properly shield the light. The backing should be attached to the grille, or framework, with black silk, and it may be cut to fit either the round or square portion of the framework. The stitches should be close together, to prevent the goods drawing away from the metal ribs.

Pattern-making

When constructing any piece of grille-work it is always best to have a full-sized drawing to work over. For example, it is a simple matter to lay out the plan for Fig. 1 A, and you may proceed as follows: Pin to a lap-board a smooth piece of heavy brown paper, and with a soft pencil draw a six-inch square. Inside this describe, with a compass, a six-inch circle; then draw the four corner circles, and divide the larger circle into quarters. In each of these quarters draw, in free-hand, the scroll shown in Fig. 1 A. The top is to be drawn in free-hand, but if it is difficult to get both sides alike you may first draw one side; then double the paper, and transfer the design by rubbing the back of the paper. It will then be found an easy matter to bend and fit the scrolls, since each member may be ac-

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curately shaped to conform to the lines, and afterwards banded together.

A Standard Screen

For a standard screen in the shape of a banner the design shown in Fig. 1 A may be used, leaving off the top ornament, and suspending it from the upper end of a supported stick with cord or wires, as shown in Fig. 8.

The stick should be about eighteen inches high, and the scroll feet should stand seven inches and a half up from the bottom. At the widest part they should measure six inches across, and there should be four of these feet to constitute a stable base. At the top of the stick (which should be about one-quarter of an inch square) a scroll and a hook will serve to support the screen. In a library or sitting-room, where one large lamp is used to read by, one or two banner-screens will keep the strong light from the eyes and the heat from the head without cutting off the needed illumination from the book or work in hand.

A Candlestick

The illustration shown in Fig. 9 gives a pleasing pattern for a small-based candlestick.

To begin with, secure an old tin or brass candlestick and rip off the bottom, leaving only the sheath and collar at the top. Have a tinsmith cut the lower end away, leaving about two inches of the top, and solder a bottom in it. Cut a pine stick about four inches long and not more than three-sixteenths of an inch square, or the same thickness as

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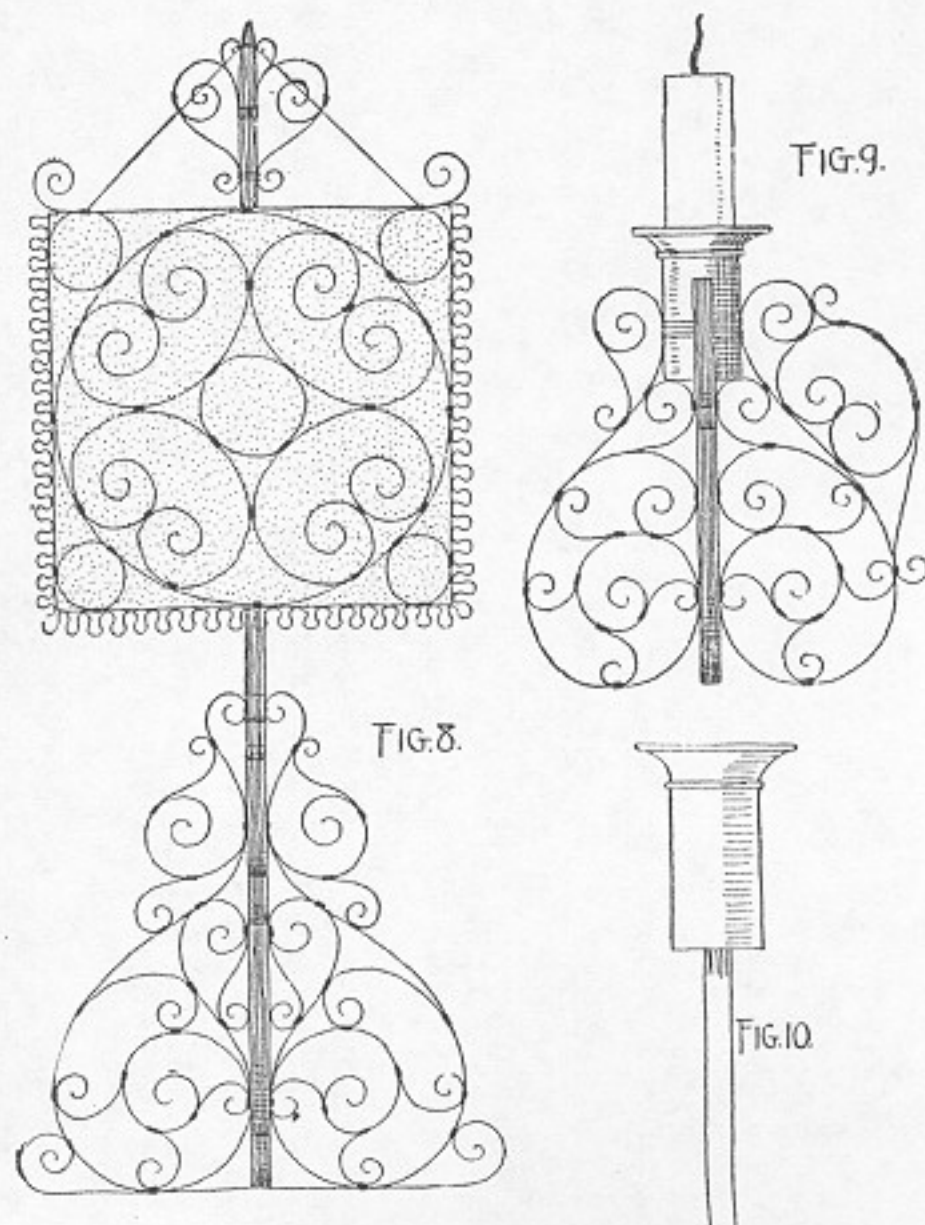
the width of the metal strips from which the scrolls are to be formed. Punch a small hole in the bottom of the socket, and drive a slim steel-wire nail down through it and into the middle of one end of the stick, so that the attached pieces will appear as shown in Fig. 10. The socket will hold a candle, and the stick will act as a centre staff against which the four scroll sides are to be fastened.

A paper pattern should be used over which to bend the scrolls, and across the bottom they should measure four and a half inches, and five or six inches high. To the upper part of one side-scroll a handle should be shaped and fastened, as shown in Fig. 9.

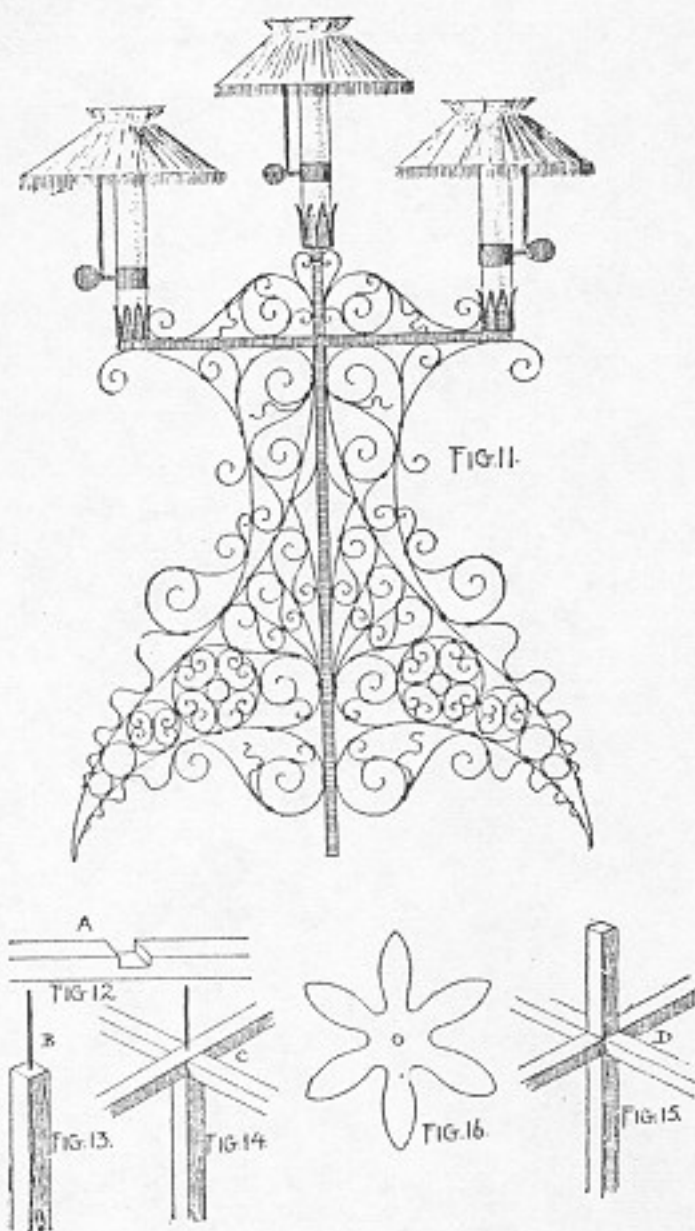
A Candelabra

The design for a four-armed candelabra to hold five candles is shown in Fig. 11.

Cut two sticks a quarter of an inch square and ten inches long, another one thirteen inches long, and a short piece two inches long. At the middle of the ten-inch lengths cut laps, as shown in Fig. 12, and bore a hole through the centre and into an end of the long stick. Drive a slim nail down into the hole at the end of the stick, as shown in Fig. 13, and over it place the cross-arms, as shown in Fig. 14. In one end of the short stick bore a hole, snug it over the top of the nail, and drive it down so that it will fit securely on top of the cross-sticks. The completed union will have



A STANDARD SCREEN AND A CANDLESTICK



A CANDELABRA

the appearance of Fig. 15, and to this wood frame the scroll and ornamental work is to be attached.

Lay out the plan of one side on paper, making the distance from the stick to outer edge of the foot about four and a half inches. At the narrowest place, near the top, the side should measure one and three-quarter inches in width. The scrolls should be securely bound to the wood frame with wire, and for candle sockets five six-pointed stars should be cut from the pattern given in Fig. 16. They should be two and a half inches in diameter, and bent to receive a standard-sized candle. A small screw passed through a hole in the centre will fasten them to the wood arms, and when placing them the wood should extend entirely under each socket, as may be seen in Fig. 11.

Canopy shades and holders should be made or purchased, and when complete with candles and shades this candelabra should present a very pleasing appearance.

A Fairy Lamp

It will be found quite a simple matter to make a fairy lamp similar to the one shown in Fig. 17.

The bracket should be twelve inches high and five inches wide from the back stick to the end of the projecting arm, on the end of which the suspending hook is located. The arm should be placed about three inches from the top, and both the arm and the upright are to be of wood one-quarter of an inch square. It would be well to make a pattern of the scroll-work over which to bend the metal in true shape.

The scrolls should be securely bound to the wood ribs with wire instead of metal clamps, since the weight of the candle-sconce would have a tendency to open the clamps and weaken the support.

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For the lamp part, it will be necessary to have the socket of a candlestick arranged as described for the candlestick in Fig. 9. The stick at the bottom should be one and a half inches in length. Against this the scroll-work is attached. Each side should measure two and a half inches long and three inches high from the place where the suspension-wire is attached to the bottom, where the pendants are fastened. The four scrolls must be securely bound to the socket and stick with wire, and from a screw-eye driven in the lower end of the centre stick three drops, or pendants, may be hung. These pendants are in the shape of bell-flowers, and may be of any size, cut from the diagram shown in Fig. 18. They should be strung on a wire having a knot made in it wherever it is desired to place a flower.

From the scroll ends of each side-grille a wire is fastened and carried up to a ring that hangs on the arm-hook. These wires form a light and graceful mode of suspension, and near the upper end a canopy shade can be made fast. Pink red, orange, light-green, or electric-blue candles and shades always look well with the black iron-work of the bracket and sconce.

A Burned-match Holder

Fig. 19 gives a design for a small receptacle to be used for burned matches or other small waste scraps.

Notice that the drawing shows but one side of a three or four sided affair. The outside frame should measure about three inches across at the top, two inches at the bottom, and two and a half inches high.

Small hooks should be fastened to each upper corner.

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From them small chains extend up to a single ring that may be of wire; or a small iron harness-ring may be employed for the purpose.

The three or four sides forming the receptacle are to be securely bound together with wire, and for a bottom a thin piece of wood or a sheet of light metal can be sewed in with wire. Whether the bottom is of metal or wood, it will be necessary to make small holes around the edge through which the fine wire can be passed. The wire should be caught around the bottom ribs of the sides, and manipulated in much the same manner that cloth is attached with needle and thread.

Each side should be backed with silk or other pretty material, and to prevent burning or blackening from match ends the entire receptacle may be relined with card-board, tin-foil, or asbestos paper.

The links forming the chain are made of very narrow strips of the metal. Fig. 19 A shows the construction of the centre, and B that of one side. Two of the latter are to be made for each link and banded to the centre, so that a finished link will appear like C in Fig. 19. The links should be connected with little wire rings, or small brass rings may be purchased at a hardware store. The latter, when painted black, will appear as if made of iron.

This same design can be carried out on a larger scale, and adapted as a hanging jardinière in which a potted vine may be placed. If employed for that purpose, an outlet for the water must be provided in the bottom. Instead of using a clay flower-pot, it would be well to have a tinsmith make a zinc inner box, with a small pipe through

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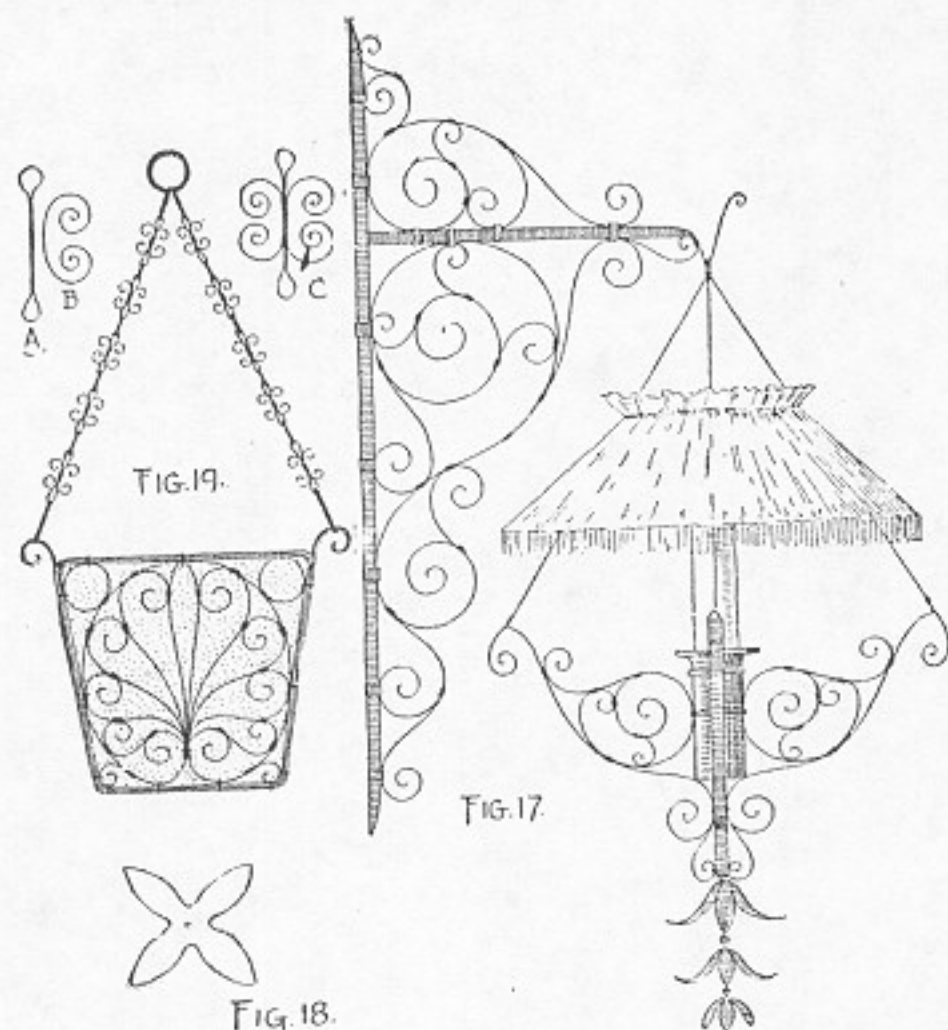
the bottom to convey the waste water into a small cup that may be suspended underneath. As the proportions of the box are enlarged, the links of the chain must be made larger and stronger, so that the chain will be heavy enough to support the weight; and instead of using wire or brass

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rings, it would be advisable to employ small iron harness-rings.

A Photograph-frame

Among the many pretty little objects that can be made from thin metal strips, frames for small pictures are always serviceable and attractive (Fig. 20). Black is not always a desirable color for a frame, and there are several good enamel paints on sale. They may be procured in almost any light shade, such as pink, blue, green, brown, and the



pale yellows or cream colors. Several successive thin coats of these enamel paints will give the iron scrolls a pretty finish.

It is hardly necessary to lay down a size for this frame, as it can readily be adapted to any photograph or small picture. The proportions, however, should be followed as closely as possible, so that the design will work out about as shown in the drawing.

This frame may be hung against the wall, or arranged as an easel for a table, mantel-shelf, or wall-bracket. If the latter scheme is preferred, a support may be made from narrow metal strips and attached to the back of the frame with wire. This support should be of the design shown in Fig. 20 A; it is attached by the top cross-bar to the back of the frame. This cross-bar is of round iron, and the projecting ends are to be caught with wire loops, which will allow the back leg to act as if arranged on a hinge. To prevent it from going too far back, a wire or string at the bottom will hold it the proper distance from the frame.

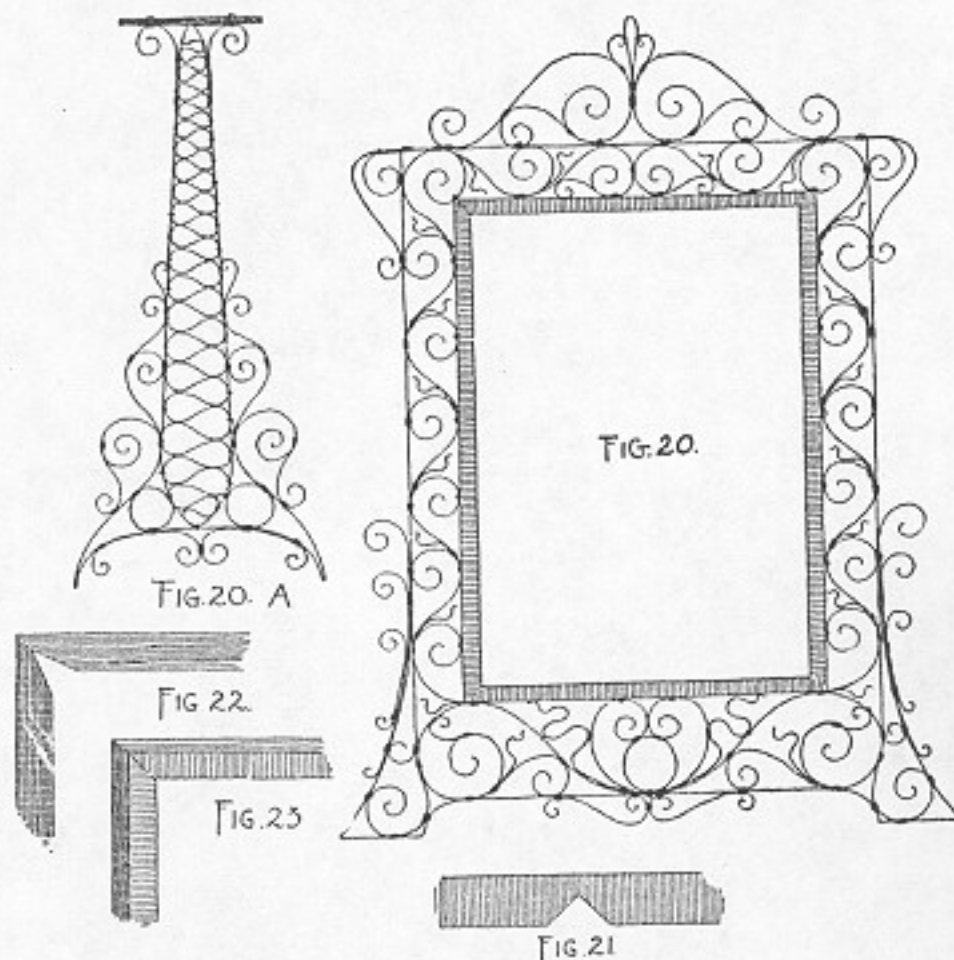
The frame proper is made from a strip of metal half an

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inch wide, and bent in angular form, showing less than quarter of an inch on each side of an L. In the strip cut angle-notches with a pair of shears, as shown in Fig. 21, thus forming the corners. The notches should be made half-way across the width of the metal, so that the point of each angle will just reach the middle of a strip. With a

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flat-nosed pair of pliers bend the strip in the form of the oblong, so that each corner will appear like Fig. 22. Join the frame at the bottom, allowing the metal to lap over an inch at the ends, and make the union by punching little



holes and passing through small copper tacks that can be clinched or riveted.

With a small bench-vise and a hammer, or with two pairs of pliers, grasp the strip forming the frame and bend it in the shape of an L all around, as shown in Fig. 23, taking care to match the edges of each notch so that they will form a mitre, as shown also in Fig. 23. Where the scrolls are attached to the side of this frame, they may be held in place by small copper tacks passed through holes made in both scrolls and frame and riveted.

A Handkerchief-box

One of the most interesting branches of the light strap metal-work is in making boxes of all shapes and sizes. The variety of designs that can be employed is practically inexhaustible, but certain general principles should be observed. For instance, a box to hold matches should be of small and neat design, while in a larger box the ornament may be more open and bolder, and the strips from which it is made should be heavier and stronger.

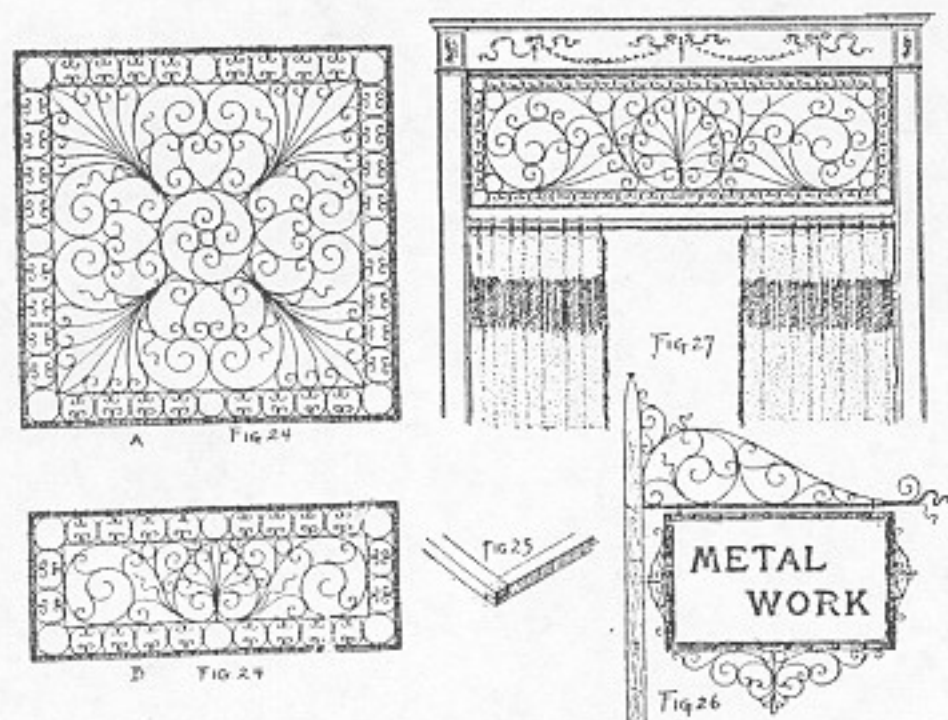
A handkerchief-box fashioned after the design shown in Fig. 24 is a pretty as well as a useful article for a bureau or dressing-table. A is the pattern for the top, and B represents one of the sides.

It should measure eight or ten inches square and three

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inches deep, or larger if desired, and the frame should be of wire or wood. If wood is employed, sticks three-sixteenths of an inch square must be lap-jointed at the angles, as shown in Fig. 25, and the union made with glue and screws or fine steel-wire nails.

If the box should be made of brass scrolls, it would be



well to obtain some brass rods about one-eighth or three-sixteenths of an inch square, and bend them to form the framework. Where the ends meet, lap-joints should be cut and wired.

If the brass should be too hard to bend in a vise without breaking, the part it is desired to work should be heated over a spirit-lamp or in a gas flame for a moment or two;

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when cool, it will be soft and pliable. If brass should be employed for the frame, the joints must be soldered instead of wired. To solder them it will be necessary to have some soldering solution, a spirit-lamp, and some wire solder.

To unite the metal ends apply some of the soldering solution to the parts with a piece of wood or an old camel's-hair brush, and then hold them over, or in the lamp flame, until they are quite hot. When sufficiently heated touch them with the end of a piece of solder, and the heat of the metal will instantly melt the solder, so that it will adhere to the brass. To hold the parts together while they are being soldered, give them a turn or two of fine iron wire. After they have been united and the brass is cold, the wire may be removed and the rough parts of the solder filed away.

Small brass hinges may be screwed fast to the wood ribs to attach the lid to the box, and if brass is employed for the frame and grille work the hinges must be soldered to the frame.

A Sign-board

For a sign-board an idea is suggested in Fig. 26. At one's place of business, in front of a cottage, or on a mile-post, it may be displayed to good advantage.

It is only a board on which sheet-iron or lead letters have been fastened, and the edges bound with metal and large-headed nails. A rod set at right angles to a post supports the sign-board, and to ornament it some scroll-work is attached at the top. Scroll ornaments decorate the sides and bottom of the board. These are fastened on with steel-wire nails driven through holes made in the metal and into

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the edges of the board. The ornamental scroll-work should

be made of somewhat thicker and wider iron strips than the more delicate articles for indoor use, and all the iron should be given one or two coats of red-lead paint before the black finish is applied. To prevent rust-marks from running down on the wood board, it is necessary to coat the back part of the letters and all iron straps which may lie against the wood. It is much better to use sheet-lead for the letters, since it cuts easier, and will not stain the wood with rust or corrosion marks.

Double Doorway Grille

For a double doorway a pretty effect is shown in Fig. 27, where a long grille is arranged at the top of a doorway, and under it the curtain-pole is attached.

The outer frame for a grille of this size should be made by a blacksmith from an iron rod about three-eighths of an inch square. The inner frame may be made of strip-iron three-eighths of an inch wide, and three inches smaller all around than the larger one. The metal strips employed to form the grille design should be three-eighths of an inch wide, and cut from box strap-iron.

The full-size drawing should be laid out on paper, over which it will be an easy matter to shape the scrolls. If the grille should be too open when the pattern is completed, some more scrolls may be added to fill the spaces, taking care not to injure the general design of the pattern.

The grille may be anchored to the wood-work of the casing

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with steel-wire nails or staples, and several coats of black should be given the iron to finish it nicely.

A Moorish Lantern

Having gained by experience the knowledge and art of working in strip-metal, and after successfully making a number of the smaller objects already described, it is perhaps time to undertake the construction of something larger and more elaborate.

As an example of such work, a very beautiful design for a Moorish lantern is shown in Fig. 28. It is not a difficult piece of work, nor is it beyond the ability of any smart boy, but it must not be attempted before a thorough knowledge of forming frames and scrolls and of pattern drawing has been gained through experience in making more simple objects.

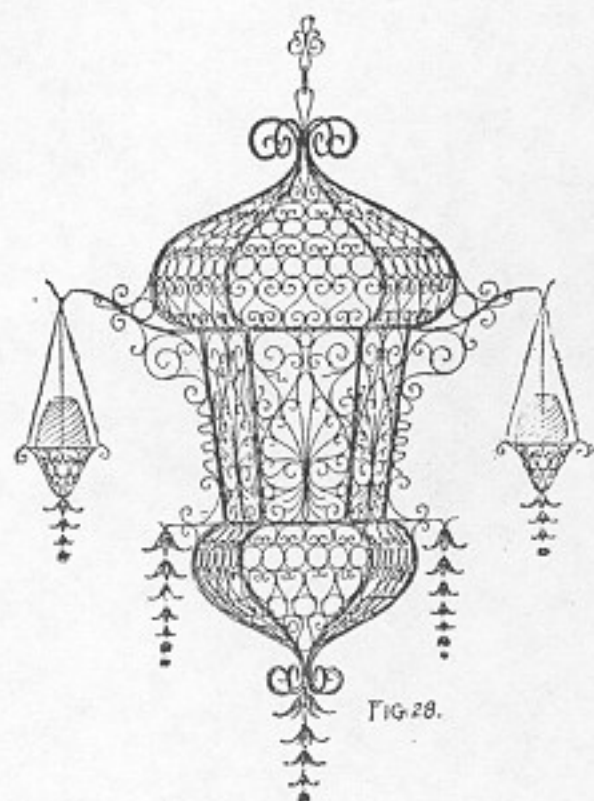
In size this lantern is not limited, and it may be made from twelve to thirty-six inches high, not including the suspension chain and rings and the drop of flower-pendants at the bottom.

For a lamp twenty inches high having six sides, each panel should be made on a wire frame. The middle panels measure six inches high, four inches wide at the top, and three inches at the bottom. The top panels are five inches across at the widest place, and the lower ones four and a half inches. One of the middle panels can be arranged to swing

on hinges, in order to place a lamp within the lantern, and also to make it possible to line the inside of the lantern body with some plain silk or other material.

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At the top and bottom scrolls are to be formed of the stout wire employed for the ribs or framework. Under the crown top, at the six corners, brackets may extend out for a distance of five inches, from which sconces for tapers or small candles may be hung. Or these brackets may be



omitted, and in place of the hooks a small scroll may be formed at the extending ends. Each little sconce is two inches deep and two and a half inches in diameter, and in them candle-holders may be placed, over which colored glass globes will appear to good advantage. From the top

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of the lower lobe six arms support flower-drops four or five inches long, and from the extreme bottom a pendant of flowers finishes off the whole. No matter what size this lantern is made, the proportions should be carefully preserved, or the effect will be spoiled.

A long chain made up of links and rings may be used to suspend the lantern. Should a more secure anchorage be desired, four chains may be attached at four places on the ceiling of a room, from which anchorage they all meet at the top of the lantern.

The illustration shows the lantern in perspective, but it must be borne in mind that it has six sides, and the patterns of the six sides, of the top, middle section, and bottom are like those in the three front sections that face the reader as he looks at the drawing.

Chapter VI

METAL-BOUND WORK

THIN sheets of various metals may be used to great advantage in the decoration of household furniture, either serving as artistic edgings, or representing strength-

ening straps, hinges, etc. When finished off with heavy wrought-iron or bellows nails, the effect is both striking and pleasing. The art is not a difficult one to acquire, and the hints and suggestions that follow should enable any smart boy to pick it up in a comparatively short time.

A Metal-bound Box

As a receptacle for photographs, picture-cards, and the other small trifles that accumulate in a library or living-room, a box such as shown in Fig. 1 will be found most useful.

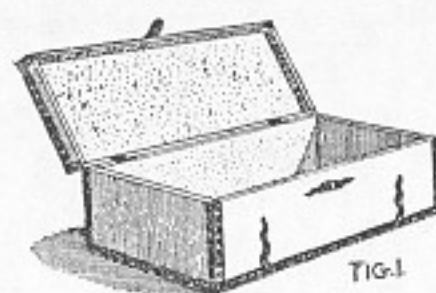
Obtain some smooth pieces of wood, not more than three-eighths or half an inch thick, and construct a box eighteen inches long, ten wide, and eight inches deep, including top, bottom, and sides. These parts are to be glued and nailed together so as to form an enclosed box. Use a good liquid glue and slim steel-wire nails to make the joints. When

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the glue is dry, cut the box through all around the sides, one and a half inches down from the top. The lid, or cover, is thereby cut loose, and it will match the body of the box much more accurately than if made separately and fitted.

Plane and sand-paper the rough edges left by the saw, and attach the lid to the back edge of the box with hinges. The outside of the box may be stained or painted any desirable color, and when dry it will be ready to receive the metal decorations.

From a tinsmith obtain a few sheets of thin stove-pipe iron of good quality, or a strip of thin sheet-lead; then, with a stout pair of shears, cut some strips about one and a quarter inches wide to bind the edges of the box. A strip is bent over so as to lap on both sides of a corner. A metal band five-eighths of an inch wide will show on each side



and also on top. The metal is to be fastened on with brass oval-headed upholsterers' tacks, and the heads may be from a quarter to half an inch in diameter.

It will not be possible, perhaps, to drive these tacks through the metal strips unless a hole is first punched. These small holes may be made with a sharp-pointed awl at regular distances apart. This should be done before the

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strip is laid on the wood, so as not to subject the box joints to any more strain than necessary.

To bind an edge, tack a strip of the metal along one side, bend it around the first corner, and so on along each side until the two sides are brought together, where a nail-head will almost hide the joint. At each corner cut a V out of the strip, as shown in Fig. 2. The metal, when fastened to

one edge, will appear as shown at the right side of Fig. 3.

When the nails have been securely fastened in, bend down the standing edge of metal so that it will lie flat on the other side of the corner. This may be done by beating it down with a light wooden mallet. Drive nails along the strip corresponding in position to those first fixed, and the edge will appear as shown at the left side of Fig. 3.

Where the angle, or ∇ , was cut out of the strip at the corners, the metal will come together and form a good mitre. In the middle of this joint drive a nail, the head of which will partially hide the line of juncture.

From the sheet iron or lead cut a few irregular strips of suitable length, and fasten them to the box to represent hinge or binding straps. The hasp and eye-plate may be made in the same manner.

The box should be lined with Canton flannel, velour, leather, or any good lining material. A band of webbing, or a chain, arranged on the inside will prevent the cover from falling back too far.

A Wood-holder

In a room where space cannot be spared for a large wood-box, a wood-holder similar to the one shown in Fig. 4 is a useful piece of furniture.

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This holder is twelve to fifteen inches square, fifteen inches high at the front, and twenty inches high at the back, with the sides cut down, as shown in the drawing.

The wood is three-quarters or seven-eighths of an inch thick, and planed on both sides and edges. Any of the hard woods may be employed to good advantage in making the box part, but if it is to be painted rather than left in the natural finish, the wood-work may be of pine or white-wood to save expense.

The metal binding is done in a similar fashion to that of the box in Fig. 1, and if iron is used for the straps they should be coated with black paint. The strips should be two inches in width, and when bent around the edges and corners one inch of metal must show on each side.

A Plant-box

For large, growing plants, palms, and imitation trees, an attractive plant-box is shown in Fig. 5.

It can be made almost any size to meet the requirements of the plant that is to live in it; but for general use it should measure twelve inches square at the bottom, eighteen at the top, and from twelve to fourteen inches high.

The metal binding should be three-quarters or an inch wide on each side; it need not be carried over the top edge unless desired.

On two sides of the box ring-handles are to be fastened. These will be made by a blacksmith at a small cost, and should be from two and a half inches to four inches in diameter, according to the size of the box.

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On the other sides a conventional design may be worked out with strips of metal cut according to the required pat-

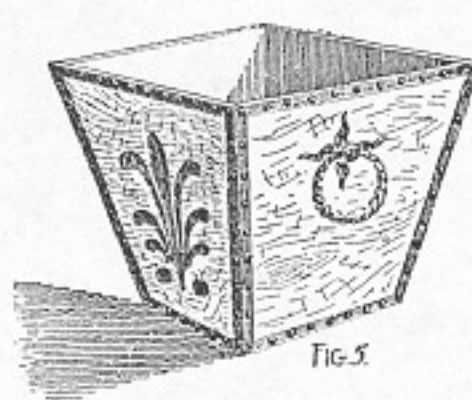


FIG. 5.

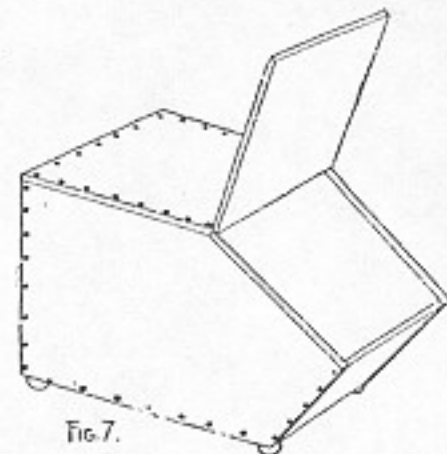


FIG. 7.

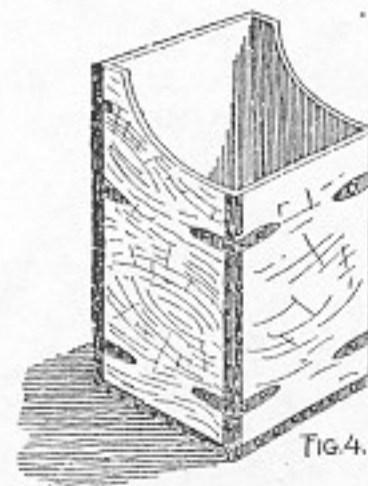


FIG. 4.



FIG. 6.

tern.

This box should be treated to several good coats of paint inside, and finished as desired on the outside. Quartered oak with black metal trimmings make a good combination; also mahogany, cherry, or red-wood with brass bindings.

A zinc lining should be fitted to the box, with a vent-hole

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at the bottom to drain off surplus moisture. No other metal than zinc should be employed for the lining, since iron or tin will corrode or rust. Copper tacks must be used to attach it to the wood.

A Coal-box

Fig. 6 gives the design for an old English coal-box.

It is a very simple affair to construct, since it can be made from an ordinary box cut down at one end so as to form a projection or nose.

The structural plan of the box is clearly shown in Fig. 7, and in size it may be made to meet any requirement. For regular use, however, it is fifteen inches wide, twenty inches long from back to end of the nose, and about twelve inches high, not counting the ball feet, which will raise it up two inches more.

The box should be securely screwed together at the joints, and the lid, or cover, must be fastened on with sheet-brass hinges. Paint or varnish will give the wood-work a good finish, and the lining should be made with several successive coats of asphaltum varnish or paint of a dark color.

Brass, lead, or black iron binding will look well on this box, and with large-headed nails the effect will be bold and pleasing.

Four balls about two inches in diameter are to be turned and screwed fast under the corners to serve as feet.

To give a good purchase on the bottom of the box, it would be well to flatten part of the surface on each ball. One

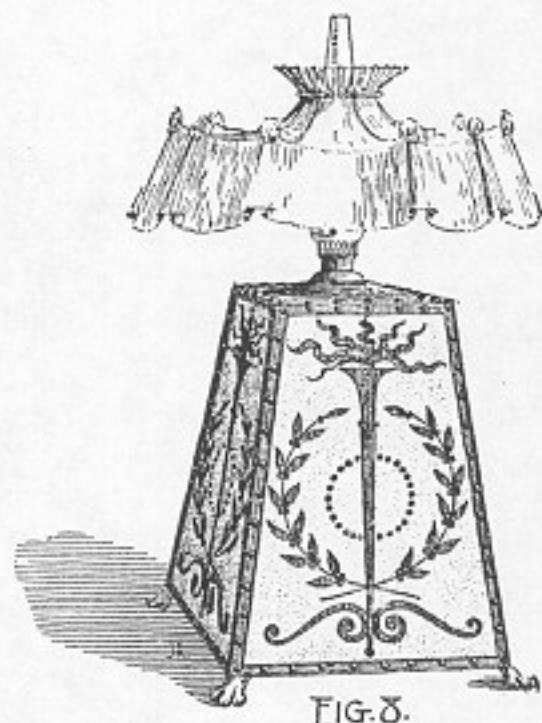
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long screw will be sufficient to anchor each foot firmly if driven through from the inside of the box into the ball. A little glue between the joint will add greatly in making the union strong.

A Table-lamp

The design for a table-lamp is shown in Fig. 8.

Any boy who is handy with tools can put this lamp together from wood, burlap, sheet-lead, wire, some oval-headed upholsterers' tacks, four claw-feet, and a lamp-fount.



From boards about half an inch in thickness make a box seven inches square at the top, ten at the bottom, and

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twelve inches high. In the top of the box a round hole is cut to receive the lamp-fount. Five inches in diameter will be about right for the hole, since that is the measurement of the standard oil-pot. A flange, or rim, all around the upper edge of the fount will prevent it from falling through the hole. If the burner has a central draught it will be necessary to bore some large holes through the bottom of the box to admit air for the under draught.

With burlap, bagging, or canvas cover the entire outside of the box, the material being fastened to the wood with glue and small, flat-headed tacks at the edges. The glue must be spread evenly over the wood by means of a rag pad, or, still better, a small photographic squeegee roller may be employed. The covering material can be painted any good shade, and when the paint is dry the box will be ready for the decorations and trimmings.

From sheet-lead, or iron, cut some strips one inch and a quarter wide, and bind the corners and edges of the box, allowing about five-eighths of an inch to show on each side. Fasten these strips on the edges of the box with large, oval-headed upholsterers' tacks, driven along each side at even distances apart, as shown in the illustration.

On a piece of smooth brown paper draw the outline of

one side of the box, and then sketch in the design for the metal torch and wreath. Over this pattern it will be a comparatively easy matter to cut and fit each of the separate parts of the design. These parts are to be of thin iron or lead, but for the stems to the laurel wreath use pieces of iron wire, and fasten them on with small staples. The staples may be made from pins with the heads cut off.

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The pieces of metal forming these side designs are to be fastened to the wood with oval-headed carpet tacks, and enough of them must be driven in each piece to hold it firmly in place. When all the metal-work has been applied, purchase at a hardware store four claw-feet, and screw one fast under each corner of the box. They will be of brass, but when painted black they will appear as if made of iron.

All the metal parts of the lamp must be blacked to present a good appearance. To make a good black finishing paint obtain at a paint store a can of ivory black ground in oil. Thin it to the consistency of rich milk with Japan dryer and spirits of turpentine mixed together, one part of the former to two parts of the latter. Place them together in a bottle and thoroughly mix them by shaking the bottle vigorously. A small quantity only should be thinned at a time and as required, since it works better when freshly mixed, and does not have the gummy appearance that an old mixture presents. Two or three successive coats laid on with a soft camel's-hair brush will be sufficient to cover the iron well and give it a good surface. When using the black take care not to smear it on the box, as it would produce an untidy and messy appearance.

With the addition of a pretty canopy shade, that can be arranged on a wire frame, the effect will be most decorative and pleasing.

A Hanging-lamp

For the dining-room or library, a hanging-lamp, such as shown in Fig. 9, is both ornamental and useful.

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The box that holds the lamp is eight inches square at the top, five and a half inches at the bottom, and five inches deep. It is covered with burlap or other suitable material, or may be left plain or painted.

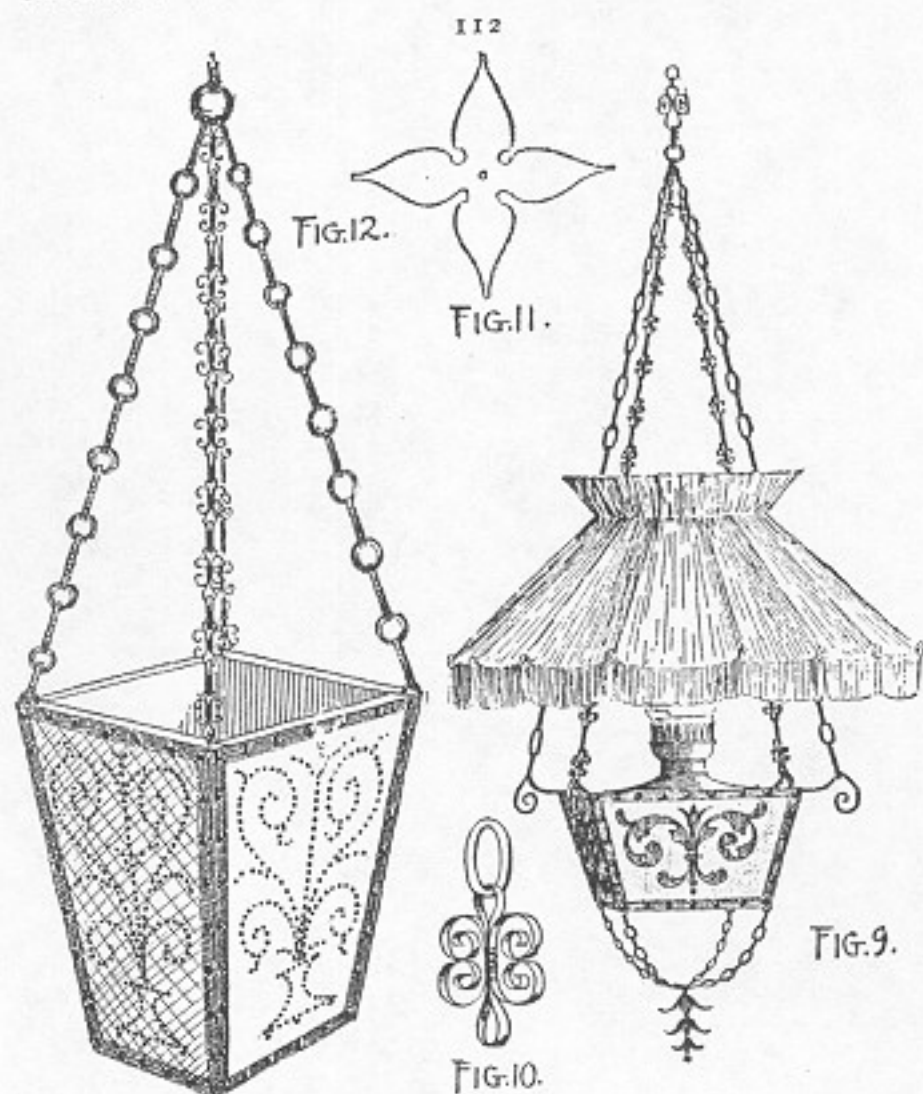
A hole is cut in the top of the box to receive the fount, and if it is a central-draught burner a large opening must be made in the bottom of the box, with a perforated metal cap arranged to fit over it.

From the top of the four corners, iron scrolls, that a blacksmith can make, project four inches beyond the wood, and to these the suspension-chains are fastened. The chains are made of one-inch iron harness-rings and links three inches long, formed of narrow strips of stove-pipe or box strap-iron less than a quarter of an inch in width, and shaped as shown in Fig. 10.

From the under side, and fastened at each corner of the box, hang four small chains. They are united at the centre a few inches below the under side of the box, and are fin-

ished off with a drop formed of metal lilies. In order to form these flowers, cut from sheet-iron the petals, as patterned in Fig. 11. Three different sizes should be drawn on a sheet of iron with a piece of chalk or white crayon, after which they may be cut out with a pair of shears and bent into form with the fingers. They are to be hung together one below the other by means of small wires, fastened to the centre of each flower through holes punched with a sharp-pointed awl.

A large paper or silk shade may be arranged on a wire frame to slip over the chains, and to hold it in place it should be fastened to some of the links with wire.



A Hanging-plant Box

For vines, small plants, or pretty blade grasses a design for a hanging-plant box is shown in Fig. 12.

This is not a very large affair, and it is made of thin wood not more than three-eighths or half an inch in thickness.

The box part measures eight inches square at the top, six at the bottom, and ten inches high.

The inside of the box is to be treated to several coats of paint or asphaltum varnish to protect the wood, and the outside may be given two coats of paint. The corners are then to be bound with metal strips, and the design on each of the four sides worked out with hobnails painted black.

It is difficult to carry out such a design on four sides of a box unless a pattern is used. To obtain the most accurate results it would be best to draw the design with pencil on a smooth piece of paper, then make four tracings of it on tissue-paper. The tracing should then be fastened to the wood with pins and the tacks driven in, following

the lines of the design.

When the tacks have been driven in part way, tear off the paper, and with a flat-iron held against the inside of the box to drive against, hammer the nails in so that the heads will lie snugly against the surface of the wood.

Each side is to be treated in the same manner, so that the four sides will be alike. If the hobnails cannot be had at a hardware store, or from a shoemaker, oval-headed upholsterers' tacks may be used. Paint them black before they are driven into the wood.

At the top of the box, in the four corners, eyes are to be made fast, into which the ends of the suspending chains can be caught. Four chains, made from thin strips of metal and small harness-rings, are to be fastened in place, as shown in the drawing.

Chapter VII

DECORATIVE HARDWARE

PROPERLY to complete even the simplest of cabinets or chests some hardware will be needed, whether it be only a pair of strap-hinges and a padlock or the most elaborate kind of ornamental fittings. Plain hinges and a lock will answer every ordinary purpose, but a nice chest or case should be finished off with ornamental hinge-straps, escutcheons, lock plates, or handles.

These fixtures may be purchased at a hardware store, and in some large cities a very beautiful assortment of fancy hardware is displayed. But it will be both cheaper and more satisfactory for the young craftsman to make these fittings for himself, and the art is not a difficult one to acquire. Some of the accompanying designs may appear at first sight rather beyond the ability of the average boy, and so they would be if they were cast in brass or bronze or cut from thick sheet-metal. But all of them can be shaped from ordinary sheet-lead with a pair of old shears, a few small chisels, and a light mallet.

Scraps of sheet-lead, varying in thickness from one to three-sixteenths of an inch, may be purchased from a plumber for five or six cents a pound. For the ordinary

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fixtures of medium size the metal should be a trifle less than one-eighth of an inch in thickness. For the heavier hardware an old piece of lead pipe may be used by splitting or sawing it open, and beating it out flat, on the surface of an old flat-iron, with a hard wooden mallet. If sheet brass, copper, or zinc are employed, they should be of the soft kind, so as to cut easily. If too hard, the pieces may be softened or annealed by putting them in a fire until they are cherry-red. They should then be drawn out and allowed to cool, when they will be found quite soft and easy to work.

The boy who owns a scroll-saw will find it an easy matter to jig out these designs, whether the material be lead or one of the harder metals. Special fret-saws may be purchased for this purpose, having finer teeth and being more highly tempered than those used for wood-working. In saw-

ing metal you must be careful not to force the saw, and after cutting an inch or two allow the blade to cool, otherwise it will break.

If a hand jig-saw is the only tool available the metal should be held in a vise. With very thin lead the dressing is best done by laying the metal on a hard-wood block and cutting out with small chisels and a light mallet.

Three or four small wood-carving chisels, straight-edges, and gouges will be found admirable tools for this work, and, as the lead does not dull them, they will keep an edge for a long time. A wood-carving chisel is ground on both sides, which makes it better for this work than a carpenter's chisel, which is ground only on one side. A light mallet, a

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hard-wood block, a coarse file or two, and a knife with a small, sharp blade will be the only other tools required.

Escutcheons

The term escutcheon, as applied to hardware, means the ornamental metal plate that is placed over a key-hole, and through which the key has to pass in order to reach the lock. The name is applied also to the plate behind a knocker, or that to which a ring or handle is attached.

In Fig. 1 a few designs for small escutcheons are shown. Their actual size should be in proportion to that of the drawer or door to which they are to be attached.

The design should be drawn to the proper size on a piece of brown paper, then cut out with scissors and laid on a piece of metal, the outline being scratched with a pin or drawn on with pen and ink.

If the metal is sawed the edges will be rough, but they may be dressed down with the files. If the lead is cut out the edges can be finished with a knife-blade, as lead cuts easily and is pleasant to work in. It sometimes happens that in cutting out the more delicate parts of the design that the chisels will distort the metal or force it out of shape. In this case the trueness may be restored by tapping the edges with a small hammer.

A small hand-drill will be found useful for boring holes in the metal, through which screws or nails pass to secure the escutcheons to the wood. If a drill cannot be had, a small awl will answer very well.

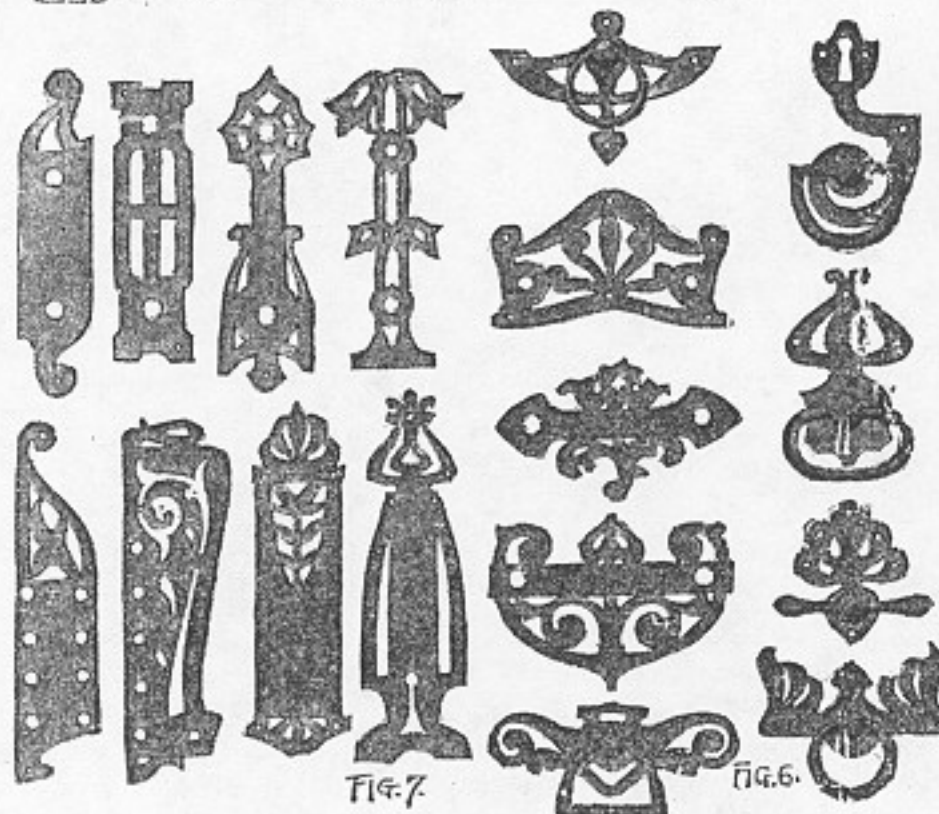
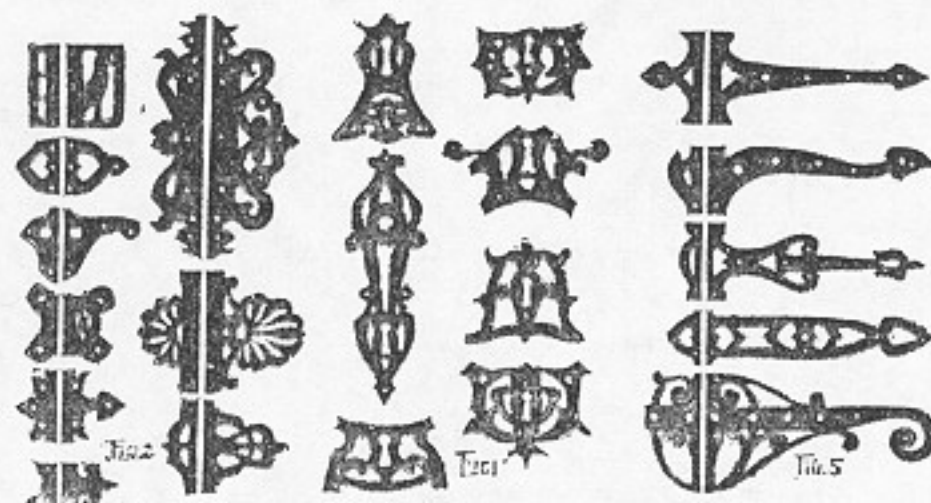
Be careful that you do not make the key-hole too large.

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It should be only a trifle larger than the key, in order to lead the latter easily.

Short Hinge-straps

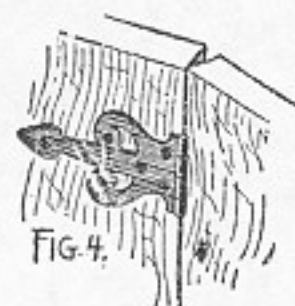
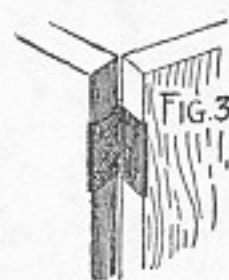
A single hinge is always made like a book, with two leaves and a back, through which a pin is run to hold the leaves together. In door-hinges the leaves are usually arranged so that when the door is closed the leaves are out of sight. These hinges are called butts, while those applied to the outside surface are called T or strap-hinges, and some-



ESCUTCHEONS AND HINGE-STRAPS

times plate-hinges.

The short hinge-straps shown in Fig. 2 are not intended as a part of the hinge, but only as sham straps. Where a butt is mounted in the wood these straps are arranged on either side of the back. Fig. 3 shows the manner in which



a butt is mounted in a door and jamb, and Fig. 4 shows the reverse side with the back protruding, at one side of which the lead strap is mounted. The inside, or parallel, lines of the straps are the edges that butt against the hinge-back, and they are to be cut to fit the width of the hinge.

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The size should also correspond generally to that of the shape and dimensions of the door or box lid. For artistic effect large sham nail-heads may be fastened over the nail or screw heads that really secure the hinge to the wood.

In some of the plain straps a very good imitation of

hand-wrought iron straps may be made by beating the surface of the lead with a hammer having the face slightly crowned or rounded. The hammer-marks will show up distinctly, and when the straps are painted black no one will know but what they are really iron straps beaten out by hand.

Another good effect may be secured by beating the edges down slightly with a small hammer instead of dressing them with a file; this rounds or flattens them, and eliminates the angular edge that is common in all cheap hardware.

Long Hinge-straps

For cabinet and chest doors, and doors that open into rooms, some long hinge-straps are shown in Fig. 5, the proportions being correctly indicated.

If the jamb is sufficiently wide, straps may be placed on both sides of the hinge-back. Usually, however, the jamb is too narrow.

These straps, if made of lead, should be thicker than the short straps, otherwise they will look weak. For a strap twelve to fifteen inches long the metal should not be less than one-eighth of an inch thick, and for some designs it would look better if quarter-inch material is used.

It is quite as easy to saw out thick metal as thin, only it

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takes a little longer time. The saw must be held straight and not allowed to bind. Never force a saw through lead, as it will bind and check, and also will pick up a thin lead coating, materially adding to the friction. If the saw does not run easily, lubricate it with a little soapy water, and afterwards wipe it off to prevent rust. When working with a scroll-saw on which there is a table, or bed, the soapy water should be drawn along the lines on the metal with a soft hair-brush. As the saw cuts it will take up the water.

Drawer-pulls and Handle-plates

Small drawer-pulls and handles may be purchased at any hardware store for a few cents each, but they are usually very plain and unattractive. Rings in heads and handles on plain plates are the best to purchase, as then the heads may be mounted on fancy escutcheons, and the handles and keepers removed from the plain plates and reset in lead mountings of artistic design, wrought or sawed from lead or other ductile material.

Drawer-pulls are generally arranged with a shank at the back of the ring-head which passes into the wood, and into which a screw is driven from the inside of the drawer.

Handle-keepers are made in the same way. In designing fancy escutcheons and plates, care must be taken to arrange the holes the proper distance apart to receive the keeper-ends.

Door-plates

On swing and sliding doors—and sometimes on plain doors—plates are mounted above the lock on both sides.

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Their use is to protect the painted or polished wood-work from finger-marks and similar defacements. Quite elaborate plates are used on some doors, while others are mounted with very plain ones. In Fig. 7 a variety of designs are shown.

The average plate varies in length from six to twelve inches. In width they measure from two and a half inches to three inches, and the metal should be about one-eighth of an inch in thickness.

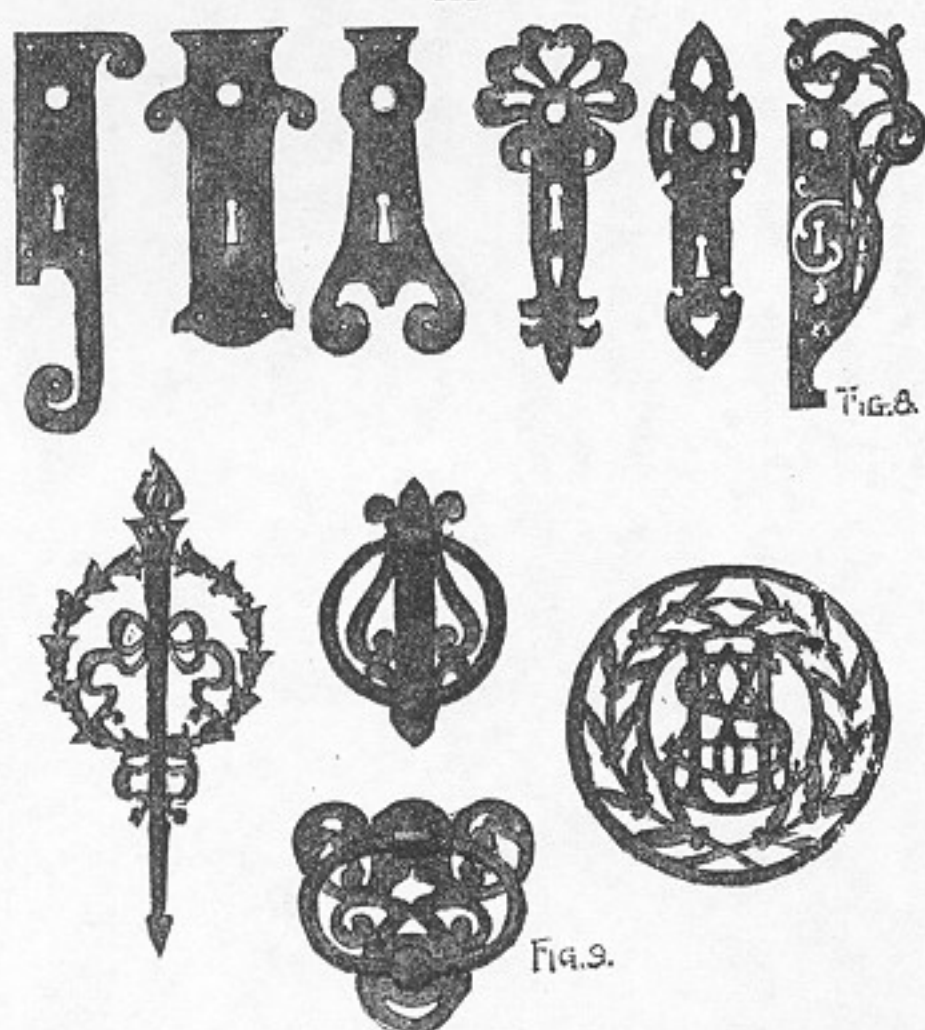
Door-pull plates are made to receive the ends of a handle. The latter is bolted to the reverse side of the door with countersunk nuts or flush screws. The upper line of drawings in Fig. 7 are designed for this purpose, and the two holes are spaced to line with the ends of the handle that is to be inserted. In addition to the anchorage these plates will get by being held to the wood under the handles, it would be well to make a few holes at the edges, through which small nails may be driven.

Large Lock-plates

In Fig. 8 several designs for large lock-plates are shown. In this instance the knob and key-hole are placed in the same plate. This variety of door hardware offers a broad field for the young designer. But be sure and space the two holes so that the knob and key are in the right place.

In the extreme right-hand plate (Fig. 8) an effect of continued scroll is secured around the key-hole by cutting the ornament out of the body of the plate. This is just the reverse of the scrolls forming the right side of the plate, the ornament in this latter case being of the solid metal.

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More "feeling" may be given to the solid scroll if an effect of relief is worked out with some blunt tool and the mallet.

This may be done with an ordinary nail-punch or a blunt awl. For the veining use an awl or a dull chisel, lightly tapping the tool with a wooden mallet.

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Door-knockers and Miscellaneous Ornaments

Door-knockers and plates are made in a great variety of designs. The most elaborate and richly ornamented knockers are cast in bronze and chased by hand, but this work is not possible for the boy craftsman to accomplish with his small outfit and limited knowledge of the higher grade of art metal-work.

The knocker-plates shown in Fig. 9 are cut from sheet-lead, but the rings in the keepers (with the knob of metal at the lower side) must be made from iron or other hard metal. A blacksmith will make these rings and set them in a head, or keeper, which in turn is bolted to the inside of a door. Where the knob of metal strikes the plate an iron nail with a large head must be driven through the escutcheon and into the door, so that the knob will strike upon it. Lead will not do for the ring or knob, nor as a striking-plate, since it is too soft to sound sharply and distinctly.

Sheet-lead ornaments in a great variety of designs may be made for panels, the sides of cases, or for the decoration and embellishment of wood-work in general. Wall-paper, carpet, upholstery, and other figured fabrics will offer ideas from which to copy; but after a little practise the young craftsman should originate his own designs, and not depend on other people's brains to furnish him with working patterns.

Chapter VIII

WIRE-WORK

THERE are many pretty and useful articles that can be made for the home, using simple tools and inexpensive materials. Who would imagine, for instance, that such attractive objects as the ones shown in these illustrations could be made from a few pieces of wire of different sizes? Yet, with a little care and perseverance, you may quickly become an expert in wire-working.

To begin with, it is necessary to obtain several yards of soft iron wire varying in sizes from No. 12 to No. 18, also a small roll of soft wire about the size that florists employ to attach flowers to short sticks when making up bouquets.

The tools needed will be a flat and a round nosed pair of pincers, or pliers (see Figs. 1 and 2), a wire-cutter, and a tack-hammer. You will also need a sheet of smooth brown paper, and a soft lead-pencil with which to draw the patterns.

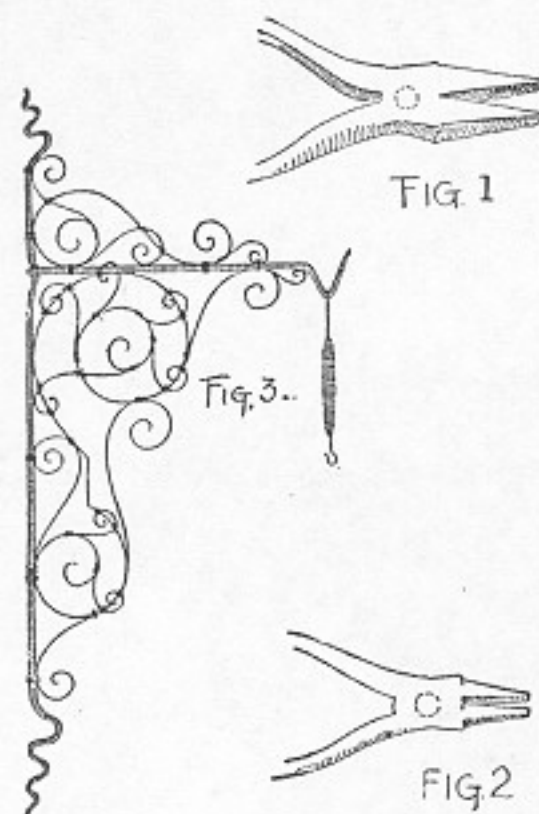
A Bird-cage Bracket

Begin by making simple things; then as you succeed in producing good work you will be able to take up the more difficult patterns. A bird-cage bracket is an easy object to

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start with. Enlarge the design shown in Fig. 3 so that it will be sixteen inches high, with the hook-arm projecting seven inches from the main upright rod.

The pattern is to be drawn out the full size on smooth brown paper; then the wire should be bent and shaped over



the lines to conform to the design. Use very heavy wire for the upright and projecting arm, and a smaller size for all the scroll-work. The finest copper wire should be used to bind the scrolls together, and so make tight unions where two edges of wire come together and where the wires cross.

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This bracket should be firmly secured to the window-casing with two staples. The staples should not be driven quite home, thus allowing the bracket to be swung from one side to the other of the casing, as though on hinges. This is especially desirable if the bracket is to be used for a hanging-basket or pot of flowers, as it can then be moved against the window or turned back to the wall, to permit of the window being opened or cleaned.

The iron wire should be given two coats of good black paint, or, if desired, it may be gilded or silvered. An excellent black preparation for iron may be made by thinning ivory-black ground in oil with equal parts of Japan dryer and turpentine. Or you may try adding a little lamp-black to brass lacquer or shellac.

The paint should be applied to the iron with a soft hair brush, and the first coat must be good and dry before the second one is applied.

If brass wire is used instead of iron the joints should be soldered, to lend additional strength. The soldering is an easy process and requires only a little care. To do it nicely, obtain from a plumber a little soldering solution in a bottle, and, with a piece of stick, place a drop of solution on each union that has been bound with the fine brass wire. Hold the union over a spirit-lamp flame, and when the wire has become thoroughly heated touch the joint with a piece of wire solder; the latter will instantly melt and adhere

to the joint. If soldering solution is not used the joint cannot be soldered, and if the wire is not hot enough the solder will not melt. If the wire should be too hot the solder will melt and fall off from the joint like a drop of

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water. A little experience will soon enable one to become an expert solderer, and the process should be employed wherever possible, as it strengthens the joints and unions, and holds them rigidly in place. Galvanized or tinned iron wire can be soldered in the same manner.

The brass wire should be painted black the same as iron, but before any paint is applied the superfluous solution should be washed off with water, as paint will not hold if applied over the soldering solution.

A Photograph Easel

Fig. 4 shows a design for a photograph easel that will make an attractive table or mantel ornament if neatly constructed from wire of medium size. It should not measure more than nine inches in height, and where the lattice-work joins the lower cross-bar two hooks should be arranged on which the photograph can rest.

A back support, or prop, to the easel may be made of wire, and soldered to the bar at the upper edge of the lattice-work. The lattice need not be made of as heavy wire as the scroll-work, and where the strands cross each other the junctions are to be securely bound with fine wire.

Larger easels may be made for small-framed etchings, for panel photographs, or for other purposes, but as the size of the easel is enlarged the thickness of the wire should be increased to give additional strength.

By reducing the size of the lower scrolls this design would be quite appropriate for a lamp-shade, and instead of the

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lattice-work a piece of prettily colored silk or other translucent material may be inserted to serve as the backing.

A Match-box

An attractive design for a match-box is shown in Fig. 5. The total height of the back piece should be nine inches, and the width three inches. The match-receptacle should be an inch deep and project one and a half inches from the wall.

It should be lined with silk or other goods, to prevent the

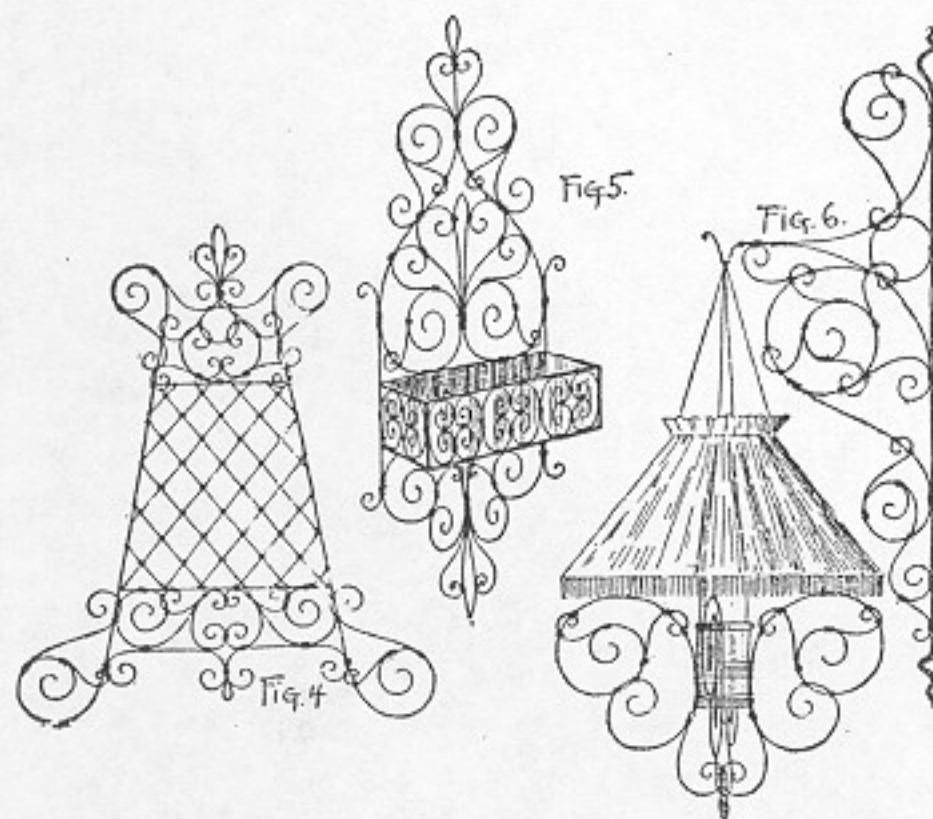
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matches falling through the open-work of the grille. Finished in black, with a red or orange colored silk lining, this match-receptacle will be found both useful and ornamental.

A Fairy Lamp

A hanging fairy lamp, like the one shown in Fig. 6, makes a pretty ornament for the parlor or living-room.

The bracket part is made in a similar manner to the bird-cage bracket, and should be of stout wire. The candle-



sconce, or lamp part, is built up of four sets of scrolls arranged about an old tin candlestick top, and securely bound together with strands of fine wire closely wrapped.

By using brass wire soldered at the unions a stronger construction is possible.

The sconce should be suspended from the bracket-hook by means of four light wires. These latter may also support a canopy shade made over a light framework of wire.

Ordinary colored candles will look well in this fairy lamp. To keep the colors in harmony it would be well to obtain candles of a tint that will match the color of the silk shade. The lamp may be fastened to a door or window casing, or perhaps to the sides of a mantel-piece.

A Picture-frame

Fig. 7 shows the design for a picture-frame that is intended to hang against the wall. The frame proper may be made of very narrow picture-frame moulding around which the grille-work is arranged. Where the latter touches

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the wood-work it is to be made fast with small staples driven in the outer edge, and the ends clinched at the inside, or rabbet, of the frame. Or fine wire may be used in place of the staples.

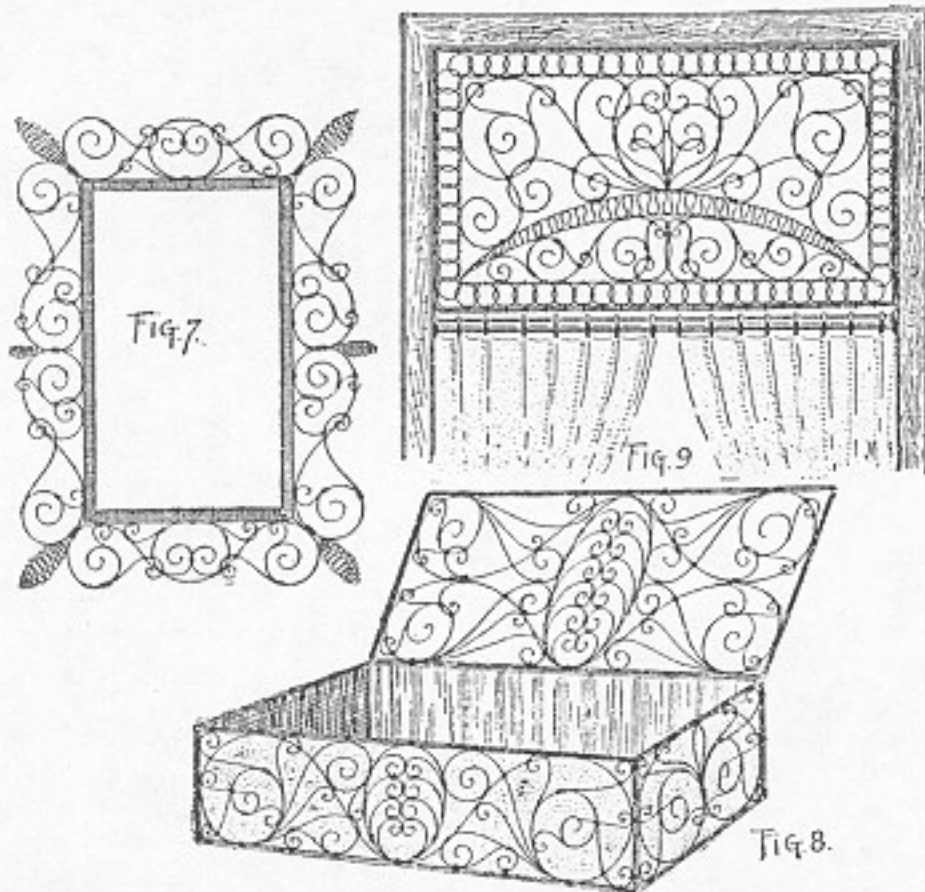
If an all-iron effect is desired, the rabbet should be made of thin stove-pipe iron or sheet-brass, bent into angular form and finally shaped to the required size. Around it the grille-work is to be made and bound, in about the same proportion as shown in the drawing.

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A Glove-box

A design for a glove-box is shown in Fig. 8. It should be ten inches long, five wide, and three inches high.

The bottom should be made of a thin piece of wood, and the entire inside, including the top, should be lined with some handsome and substantial material in bright colors.



The four sides and the top should be made in separate pieces, and afterwards bound securely together with fine wire.

A Window-grille

Fig. 9 is a grille for the upper part of a window. It will be very effective if constructed of heavy wire, the design being neatly carried out. Variations of this grille may be made for doorways, transoms, and skylights, and with the hints and drawings already given a bright boy will soon be able to invent and work out his own designs. There are dozens of other objects that may be made in iron-work, and these will soon suggest themselves to the young craftsman.

Chapter IX

GAS AND ELECTRIC SHADES

SHADES for gas and electric fixtures are a necessity in almost every house, and by the exercise of a little inventiveness they may be a part of its ornament as well. In the suggestions and hints that follow the aim has been to create from inexpensive material really artistic results. It all depends upon the care and ability with which the young craftsman goes to work.

A Simple Gas-shade

Fig. 1 is a simple shade intended for a bracket gas-burner; in shape and size it fits the rim that holds the ordinary glass globe.

From covered hat-wire four or five forms are constructed like the pattern, Fig. 1 A. They should be of such width at the bottom that when attached together and bent in a circle they will fit in the rim that is on the fixture. Each form is then covered with China silk of some light, pretty shade, and bent over, as shown in the drawing. Some

spangles are sewed to the outer surface to form the design, or pattern, and the fine lines are worked out with silk or

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laid on with gold thread. Between each section some glass beads are strung, and the other details may be gathered from the drawing.

Another Gas-shade

In Fig. 2 another idea is shown for a gas-shade. Six frames of wire are made, as shown at Fig. 2 A, and the ornament is formed of wire, and held in place by means of very fine wire wound round the unions. When the six sides have been made they are bound together so as to form a hexagon (Fig. 2 B), and with stout wires this frame is made fast to a rim, inside of which a glass shade may rest, if desired.

The inside of this frame is lined with light silk, and to the lower edge a glass-bead fringe three or four inches long is made fast, as shown in the drawing.

A Metal Shade

In Fig. 3 an odd shade is shown. It is cut from thin sheet-lead with a small chisel and pen-knife blade, the metal being laid flat, as shown at A, and the design being first drawn out with pen and ink. The ends of the strip of lead are caught together with small copper tacks, which should be driven down at the ends the same as rivets.

In order to obtain the flare at the top, the lead should be beaten out with a light tack-hammer or a round piece of hard-wood, until the proper shape has been obtained.

The metal-work should be painted black, and to lend a

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better finish the filigree shade may be lined with pink or orange-colored China silk.

An Electric-light Screen

In homes where electric lights are used it is often desirable to partly hide or subdue the harsh light from the

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bright filament within the bulb. A ground-glass bulb answers the purely utilitarian purpose, but there is no reason why the screen should not be decorative also.

In Fig. 4 an attractive design is shown. Four or five triangular wire frames are made and filled with wire ornaments, as shown at Fig. 4 A, and they are caught together at the sides so that they will form a cap, or hood, over the bulb. A band of thin sheet-lead is run around the edge, and to it the glass-bead fringe is sewed fast through small holes that may be punched in the metal with a fine awl.

The cap is lined with silk, and the beads should correspond with it in color.

A Bell-shaped Shade

In Fig. 5 a bell-shaped shade is illustrated. It is made up of five sections, as described for the gas-shade in Fig. 1.

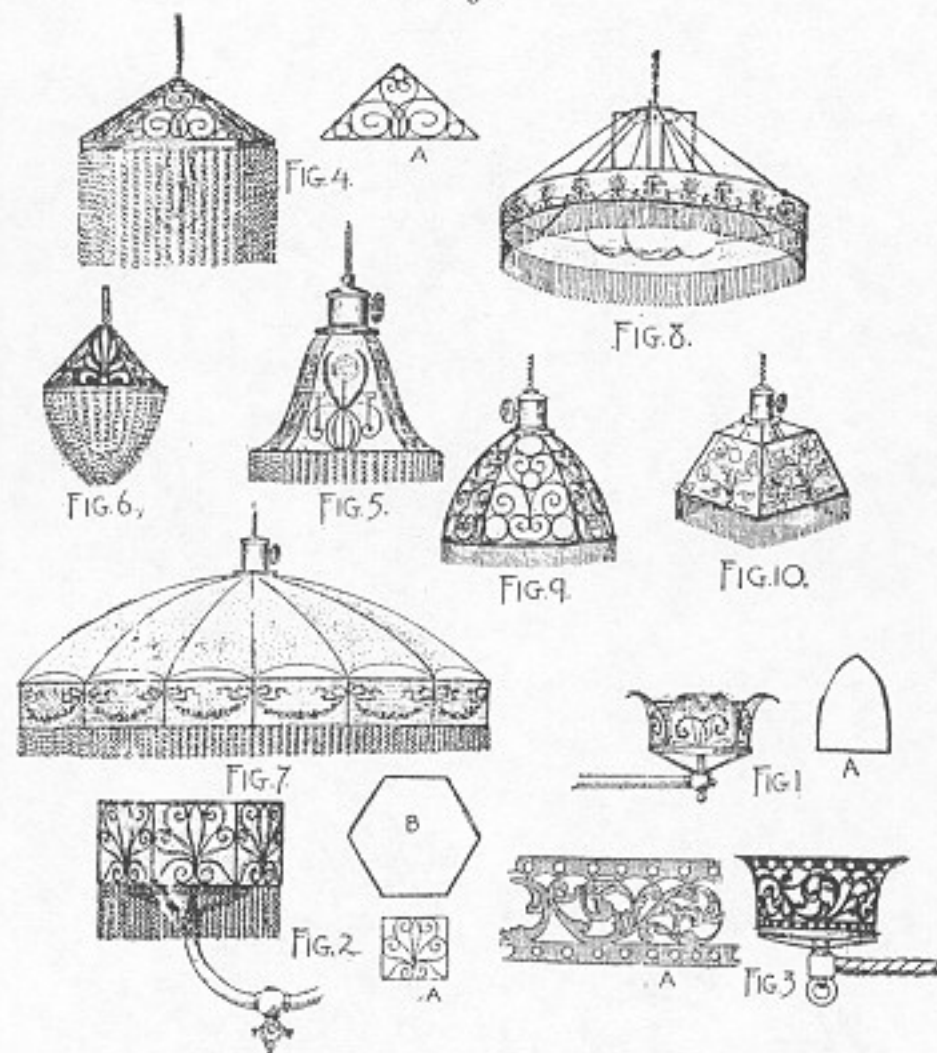
The ornament may be embroidered or painted with water-colors, or the sides may be left plain. A line of short glass-bead fringe around the bottom will add to the appearance of the shade.

A Pear-shaped Shade

In Fig. 6 the cap is cut from thin sheet-lead. The four or five separate parts are caught together at the edges with fine wire drawn through small holes, and all the metal-work is painted black.

Long glass-bead fringe is attached to the lower edge of the cap, and the ends are caught together at the bottom.

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A Dome-shaped Shade

For a dining-room, where a cluster of lights is used, a good idea for a dome-shaped shade is shown in Fig. 7.

This is made from a silk parasol lined with white. In order that the ribs may hold it in shape, saw off the stick just below the catch and pass the electric-light wire through the silk at the middle of the top.

A number of panels are made of the same width as the distance between the ribs; they are caught to each other and to the end of each steel rib with fine wire. The panels are made of wire and covered with thin China silk, which is ornamented with garlands and ribbons, either embroidered or painted on, as shown in the drawing. Glass-bead fringe should depend from the lower edge of these panels, and it should match in color the silk of the parasol and the panels.

Another Dining-room Shade

Another idea for a dining-room fixture is shown in Fig. 8.

It consists of two wire hoops held about six inches apart, the edge of a band of embroidered silk being caught over each hoop. These hoops are suspended from a circular disk of wood, which in turn is supported by means of the flexible wire that conducts current for the light. The bulbs are enclosed in frosted glass globes, three or four of which are suspended in a cluster at the centre of the hoop. A long silk or a glass-bead fringe ornaments the lower edge of the band.

Another way of arranging this fixture is to carry the globes to the inside of the band. From four to seven of them may

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hang just inside the band, which, in that case, may be made seven or eight inches wide instead of six inches.

The globes should be of a size to accommodate eight-candle-power lights.

In making any of these shades it would be well to cut the forms from card-board, and paste them together to form a pattern from which to shape the metal parts.

A Canopy

In Fig. 9 a canopy of thin metal strips and silk is shown.

The strips are cut from thin stove-pipe iron, brass, or copper. The soft metal is preferable to the hard, or spring, brass, as it can be more easily bent and it will keep the shape better. A paper plan may be drawn of one section, and the small scrolls fitted over it, then banded together with fine wire. The bottom of this canopy is round, but the six sides are slightly flattened at the middle, half-way between the top and bottom.

The inside of the canopy is lined with light silk, and silk or glass-bead fringe is attached to the lower edge.

A Panel Shade

Fig. 10 shows a simple shade made of four panels composed of covered wire and thin silk. The ornamental design may be embroidered, or painted or cut from colored silk and sewed on.

This shade may be suspended from the socket by means of silk cords or wires, and the open spaces at the top will permit some light to glow above the shade.

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Chapter X

RELIEF ETCHING

IN this era of practical craftsmanship there is a field for any unique art that savors of originality and which will help to beautify the home and its furnishings.

Relief etching is one of these arts, and is a very old one, having been employed by the workers on King Solomon's temple, and perhaps in earlier historical buildings. That was before the time of chemical treatment, however, and when the beautiful effects were obtained by laborious hand-

work, a modification of which is handed down in the Turkish, Russian, and Oriental hand-etched brasses and silver goods.

Modern science and chemistry have superseded the old method, and many beautiful pieces of relief etching are produced by the acid process, which is much more beautiful in some respects than the tool-work. The process is very simple, and any boy can become master of the art in a short time and at a very moderate cost.

The equipment necessary to the work will be a tray for the acid bath, a small can of asphaltum varnish, three or four camel's-hair brushes of assorted sizes, a bottle of nitric acid, and some pieces of sheet brass or copper less than one-eighth of an inch in thickness.

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For the acid bath a photographer's porcelain or hard-rubber developing-tray will be just the thing, but if not available a good pine or white-wood tray can be made with sides two inches high.

To protect the wood from the action of the acid, the tray should be treated to several successive coats of asphaltum varnish—one each day until the wood is thoroughly coated and the joints well filled. The wood should be half or three-quarters of an inch thick, and screws should be used at the joints and laps. A tray of this description can be made at home, and when finished it should appear as shown in Fig. 1. If the varnish is too thick when applying it, a little turpentine will thin it properly.

Small, flat subjects are best to begin with, such as hinge-plates, panels, escutcheons, or tablets. For a drawer panel, Fig. 2 shows an attractive and simple design that may be drawn on the metal with pen and ink. If the ink creeps, the surface of the metal may be roughened slightly with fine emery cloth.

With the asphaltum varnish the design is then filled in so it will appear as shown in Fig. 3 and allowed to dry, when, as a precautionary measure, another coat should be given over the blackened surface, to avoid the possibility of the acid biting through the thin places, or where the varnish has missed the metal. The back and edge of the metal is coated also, to prevent the acid from eating into it.

All the surfaces of the metal not covered with the varnish will be eaten or etched away and left with a granular surface resembling fine sand-paper, while the painted or protected parts will be left intact and with a smooth

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surface like the original face of the plate, as shown in Fig. 4.

The Technique of the Process

With an old woollen cloth dipped in turpentine, the surface of the plate may be rubbed, after first washing off the acid. The black removed from the ornament will tint the granulated surface of the background and lend relief to the bright surface of the ornament.

Almost any objects in metal, such as door-hinges, knobs, fireplace hoods, name-plates, vases, candlesticks, panels, and tablets, can be decorated by this process, and if artistically

done the results will be very effective.

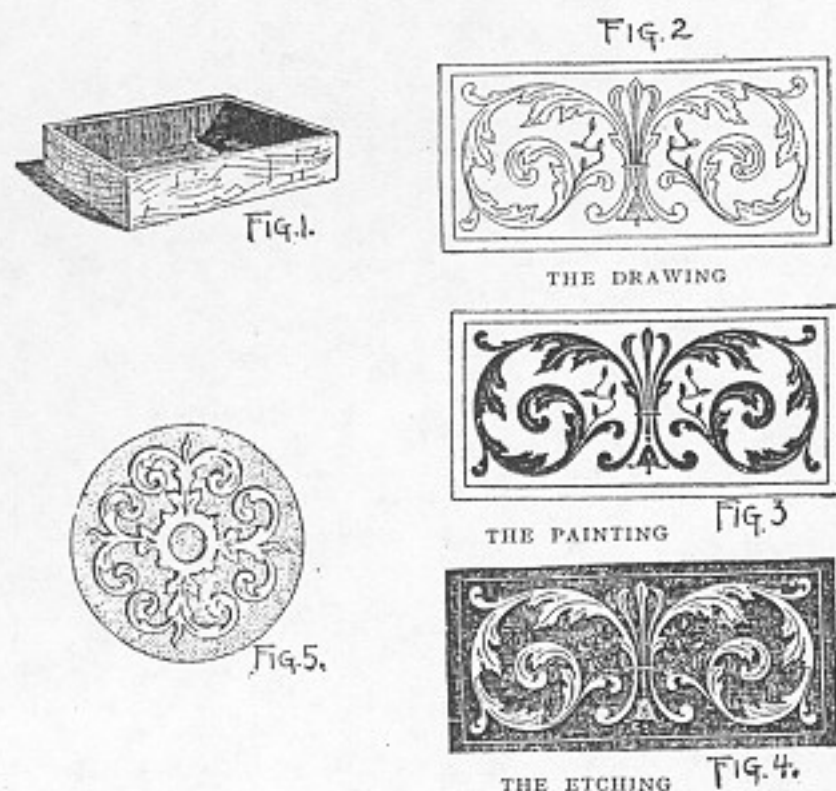
Sheet brass and copper may be purchased at large hardware stores or supply houses for thirty cents a pound, and the sheets or panels can be cut there with the shears to the exact size required. For the average work, metal not more than one-sixteenth of an inch thick will be found easy to handle; but for large panels or name-plates, pieces about one-eighth of an inch thick are preferable.

If the design shown in Figs. 2, 3, and 4 is too elaborate for the beginners, some simple outline may be drawn, perhaps a flower design, copied from some piece of embroidery work, or a figure design from a wall-paper, carpet, or dress-goods pattern. The metal should be left to dry for at least an hour after being painted with the varnish before it is placed in the acid bath.

The etching is done by placing the plate, face up, on the bottom of the tray and covering it with acid. The ground-work or unpainted portions of the metal may be bitten to

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any depth, but it is not desirable to cut away too much, as it weakens the plate and cuts under the ornament, unless it is carefully stopped out all around the edges of the design; and that is too much of an undertaking for the young



craftsman, since it requires a great deal of time and careful work.

A little practice will determine just when the plate should be removed from the solution, either for examination or final cleaning. Soft brass or copper corrodes much faster than hard metal, which takes about three times longer, and

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the process of corrosion will require from twenty minutes to an hour, according to the temper of the metal and the strength of the acid solution.

The Acid Solution

To prepare the acid solution obtain a large, clear glass

bottle and fill it quarter full of pure water; into this slowly pour an equal quantity of nitric acid, taking great care not to spill any of the acid, as it acts instantly and will eat a hole in any cloth it falls upon or spatters over. Wear old clothes and a canvas apron when mixing or handling the acid, and never be in a hurry to get results quickly by the reckless use of the biting fluid. If perchance the acid should touch the clothing, apply a few drops of ammonia to the spot immediately, to neutralize the acid and stop its action. The spot should then be sponged with clear water and no stain will be perceptible.

As the acid is added to the water (never add the water to the acid), shake it occasionally to thoroughly mix it, and let the mixture stand for a while to cool; then place a rubber cork in the bottle, label it Nitric Acid Solution—POISON, and place it beyond the reach of small children.

A solution that has been used should be poured from the tray into another bottle, to be used again by adding a small quantity of fresh solution. An old solution does not act as quickly as a new one, but for soft metal plates it is preferable, as it does not require such careful watching. The fumes of the acid, when at work, are disagreeable, so if possible it is well to carry out this part of the process in the

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open air. After the plate is immersed in the acid, do not handle it with the unprotected fingers.

Rubber gloves may be used for this purpose, but if a pair cannot be had the plate may be raised from the tray bottom by means of a small, sharp-pointed stick, and it should then be grasped with a pair of pliers and immersed in water to stop the action of the acid. A plate may be repeatedly removed from the bath to watch the progress of the etching, but in doing so it must be handled with care, in the manner just described.

When the ground is etched deep enough, remove the plate from the acid and give it a thorough washing in clean water; then with a soft cloth dipped in turpentine rub off the entire surface of the plate. The turpentine will dissolve the varnish and leave a film of it on the granular surface of the metal eaten by the acid. As a result, the ground will be darkened or oxidized, while the parts originally protected by the varnish will be bright and smooth. The high parts can be brightened still more with metal polish, or they may be buffed and lacquered by a metal finisher.

Some Typical Designs

In Fig. 5 the face of a door-knob is shown in its etched state, the pattern being drawn in varnish, as described.

In Fig. 6 the side of the knob in Fig. 5 is shown; that is, if it should have such a flat band all around. Plain brass knobs may be purchased at a hardware store, and if they are lacquered the coating should be removed with alcohol

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before the etching is done, as otherwise the acid would not eat through the lacquer for some time.

For an acid bath in which an object this shape is to be etched, a yellow earthenware bowl may be used, or a low jar with a wide neck will answer very well. The knob should be suspended in the acid by means of a piece of waxed string tied about the shank.

Hinges on cabinet doors may be greatly improved by making brass straps for them, which should be applied to the wood so that they fit closely against the sides of the hinges.

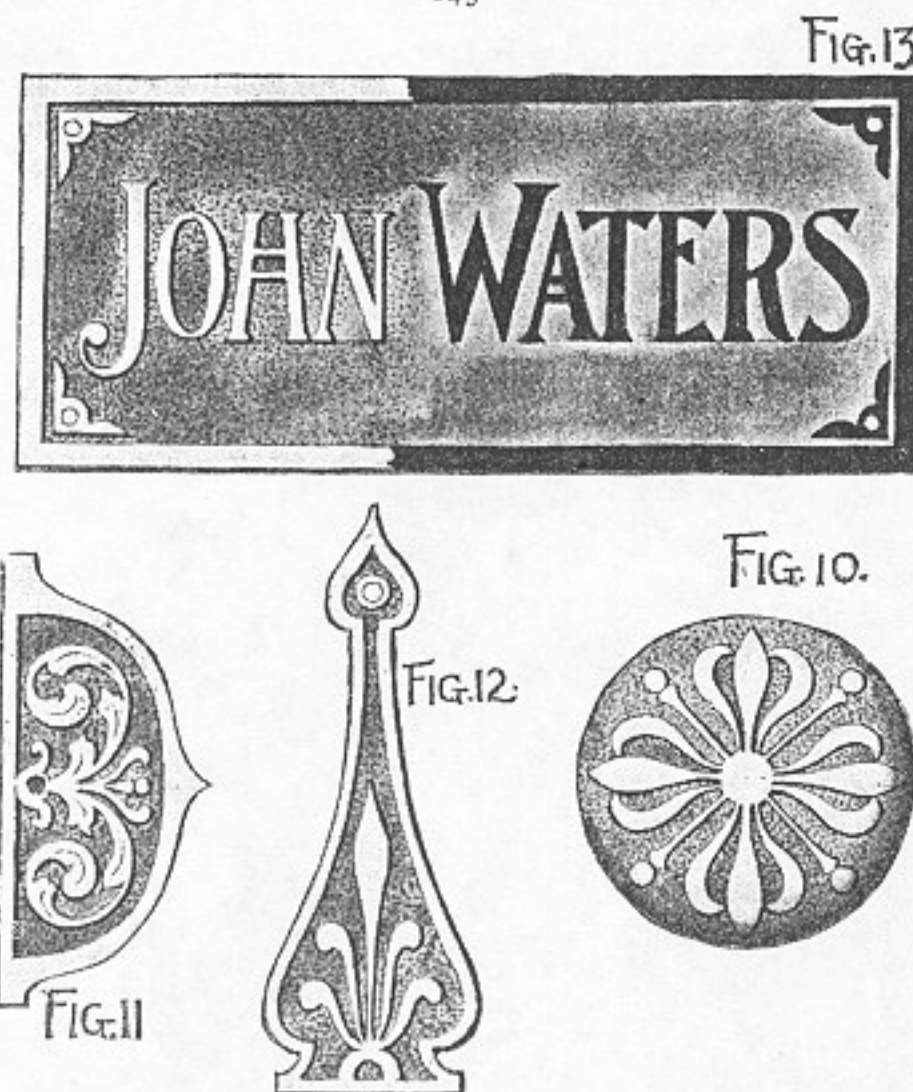


Designs for hinge-straps are shown in Figs. 7 and 8, and Fig. 9 is a brass vase on the outside of which a floral design has been etched.

Another design for the face of an oval brass door-knob is shown in Fig. 10. This is a simple pattern to draw on a knob with asphaltum varnish, and its plain but bold ornament is quite as pleasing to the eye as a more intricate pattern would be.

A design for a short, high hinge-plate is shown at Fig. 11, and at Fig. 12 a long, narrow hinge-plate or hasp-strap is depicted. Many other shapes of hasps and the patterns

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to ornament them may be designed by the boy with some artistic ability, and he may be able to improve upon these

suggestions.

When making hinge-straps, escutcheons, or any articles

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from brass plates or flat brass and copper, the edges should be shaped with a cold-chisel and mallet on the upturned face of an old flat-iron. The uneven or ragged edges may be trimmed off with a file and finished with emery cloth.

An idea for a name-plate is shown in Fig. 13. This is seven inches long and three inches wide. It is appropriate for a front door or the door of a boy's room, changing the name, of course, to that of the proper person.

At the left of the drawing the finished plate is shown, while at the other side the blackened letters and marginal line is depicted, illustrating how the plate will look before it is etched. Or this last may be the appearance of the plate after it is etched and before the varnish has been removed with turpentine and a cloth.

Chapter XI

CLAY-MODELLING AND PLASTER-CASTING

THE boy on whom nature has bestowed the natural talent and liking for art-work will find clay-modelling a fascinating and pleasing branch to follow.

To become a perfect modeller, and finally a sculptor, requires years of patience and perseverance, but to copy simple objects in clay is not a difficult matter, and with some clay, a few tools, and the skeletons, or supports, the amateur should not meet with any great obstacle if the following descriptions and instructions are accepted and practised.

Very few tools are necessary at the beginning, and Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11, shown in Fig. 5, are a full complement for any beginner. The first four are wire tools, made of spring-steel or brass wire, about which fine wire is wrapped. The ends of the wires are securely bound to the end of a round wooden handle, and sometimes, for convenience, two ends are made fast to a single handle. These tools are called "double-enders," and are used in roughing out the clay in the first stages of the work. No. 5 is a boxwood tool with one serrated edge, and is used for finishing. The tools shown in Nos. 6 and 7 are of steel, and are of use on plaster,

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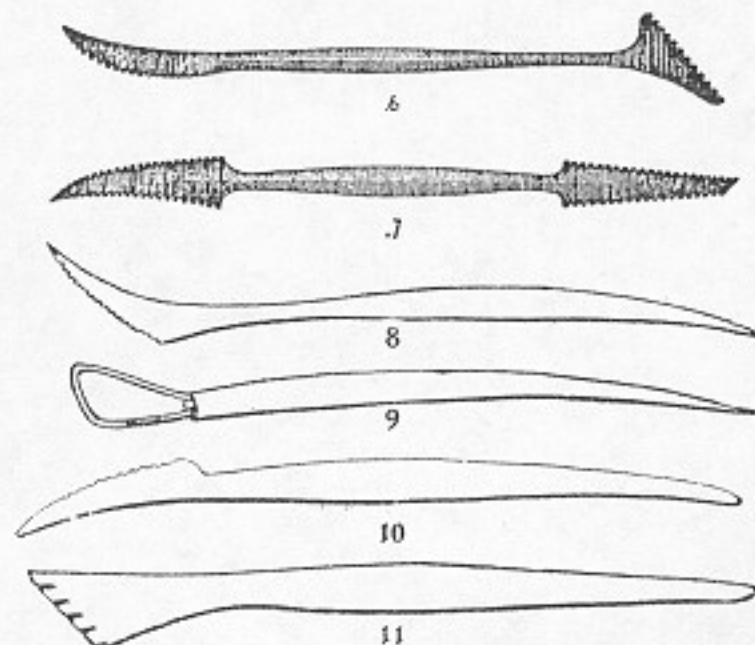
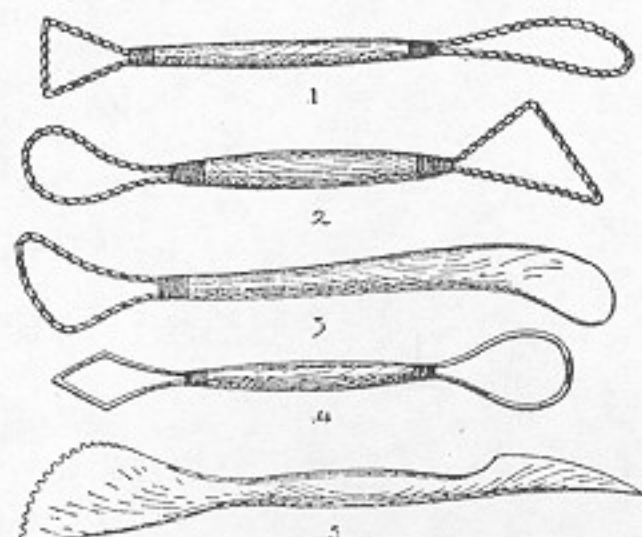


Fig. 5

THE TOOLS

where others would not be sufficiently durable. Nos. 8, 9, 10, and 11 are boxwood tools, a wire loop being fastened in the end of No. 9. Any of these tools can be purchased at an art-material store for a few cents each, except the steel tools, which are more expensive.

A stand, or pedestal, will be necessary on which to place the clay model, unless perhaps it should be a medallion, which may be worked over on a table.

Fig. 6 is a stand that can be made by any boy from a few pieces of pine two inches square and a top board one and a half inches in thickness. It is arranged with a central shaft that may be raised or lowered, and to the top of which a platform is securely attached.

The movable shaft should have some holes bored through it from side to side, through which a small iron pin may be adjusted to hold the platform at a desired height. Clay can be purchased at the art stores by the pound, or in the country a very good quality of light, slate-colored clay may sometimes be found along the edges of brooks or in swampy places where running water has washed away the dirt and gravel, leaving a clear deposit of clay of the consistency of putty.

Supports which the clay models are built upon can be made of wood and wire, as the requirements necessitate. That for the head is shown in Fig. 1. Nearly every clay model of any size will need some support, as clay is heavy and settles, and if not properly supported will soon become distorted and the composition spoiled. You will also need some old soft cloths that can be applied wet to the clay, a pair of calipers, and a small trowel or spatula.

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The Technique of the Art

To model well the art of drawing is indispensable. The art of wood-carving is also a valuable one to the clay-modeller, but care must be taken when making any casts of wood-carving to use glue moulds; otherwise the carving would become firmly embedded in a plaster mould, due to the undercut in the carved ornament. To begin with, choose some

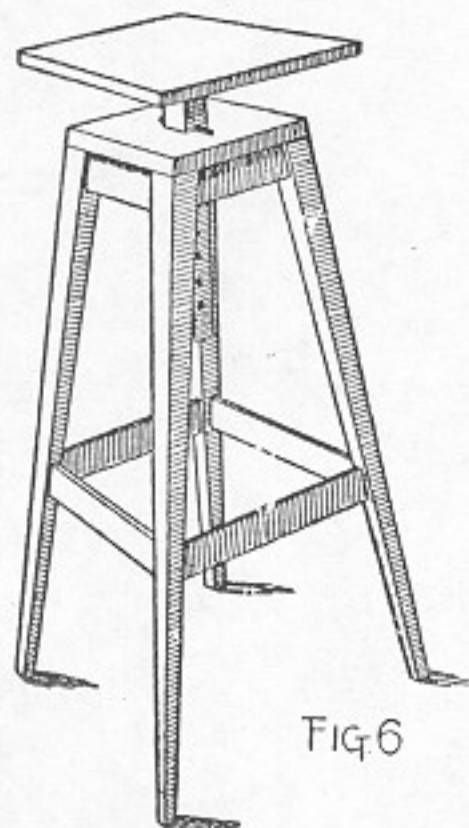


FIG. 6

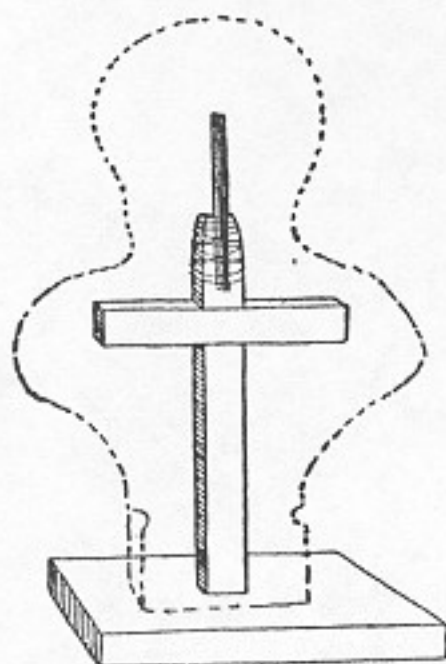


FIG. 1

simple object to copy, such as a vase or some small ornament; then, when a satisfactory result has been obtained,

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select something a trifle more difficult, such as a hand or foot.

When copying a head, obtain a bust support on which to work the clay. A very simple and strong one can be made from a piece of board, two sticks, and a short piece of pipe wired to the top end of the upright stick (Fig. 1).

To carry out the proportions of a bust similar to Fig. 4, the clay should be packed about the support much after the manner shown in Fig. 2. This will support the clay.

With a lump of clay and the fingers form the general outline, as shown in Fig. 2, for the head; then, with the wire tools, begin to work away the clay in places, so as to follow the lines of the model. With the calipers measurements may be taken from the plaster head and used advantageously in the building up of the clay model. Turn the plaster model and clay copy occasionally, so that all sides may be presented and closely followed in line and detail. Fig. 3 shows the next stage, and Fig. 4 the completed head.

Modelling differs from drawing and painting in that every side of the model is visible, while only the face of the painting is presented to the eye, the impression of form and outline being worked out on a flat surface.

Having successfully mastered the head, next attempt a foot from a plaster cast. Afterwards a more elaborate subject, such as a whole figure, can be tried.

With the wire modelling-tools and the fingers begin to work away the clay to obtain the general outline and form; continue this in a rough manner, until a perfect composition is obtained that compares favorably with the original model;

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the finishing-touches may then be applied, and the detail worked up more carefully.

Never complete one part and leave the remaining ones

until later; always work up the model uniformly, adding



FIG. 2



FIG. 3



FIG. 4



FIG. 7

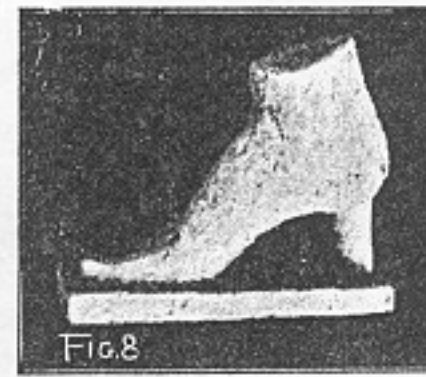


FIG. 8

a little here and there, or taking away, as may be necessary, and so developing the whole composition gradually.

Moisten the clay occasionally with water sprayed on with a small watering-pot or a greenhouse sprinkler, to

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keep it soft and ductile. When not being worked upon it should be covered with wet cloths, to keep it moist.

As the work progresses the clay may be allowed to harden and consolidate, but not to dry; if allowed to dry entirely the model may be considered ruined, as the shrinkage of the clay around the support results in fissures and fractures that cannot be repaired.

By the time the amateur has acquired the knowledge to attempt a full-size figure he will be able to invent the devices to support it.

The support, or skeleton, must of course be adapted to line with the pose of the figure, and should be of pipe and heavy wire or rods securely anchored to the base-plate.

The composition of flowers, fruit, foliage, animal life, and landscape is an inexhaustible one, and some beautiful effects can be had in flat-work. Good examples of this character of work may be found on all sides, and to the genius the field of modelling is a broad one—without limit.

Glue and Gelatine Moulds

When casting from hands, feet, or ornaments where undercut predominates, the most successful mode is in the use of gelatine or glue.

To cast a head similar to the one shown in Fig. 4 it will be necessary to make a box frame large enough to hold the head.

The cast is to be well oiled, and down the front and back, running around under and back over the base block, strong

linen threads are to be stuck on with oil. Warm glue or
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gelatine is then poured in the box and left to chill and solidify.

When sufficiently cold the frame may be removed, leaving the solid block of glue like hard jelly; then the ends of the threads are to be grasped and torn through the gelatine, thus separating it in two or three parts. The plaster head may then be removed, and the mould put together again and surrounded by the frame to hold it in place.

To make a plaster head this plaster of Paris may be poured into the mould and left for a while, when, on removing the frame and taking the glue mould away, a perfect reproduction of the original head will be found.

Hollow Casting

When very large objects that would require a great deal of plaster are cast, they are generally made hollow in the following manner:

Obtain the glue mould by the process described, and into it pour a quantity of thin plaster, having first oiled the surfaces that come in contact with it. Turn the mould about and upside down, so that the plaster will enter every part and adhere to the glue form. Allow it to "set," and again pour some plaster into the mould. This will adhere to the first coating, and after it has set repeat the operation several times, until a deposit, or coating, an inch or more in thickness has been made.

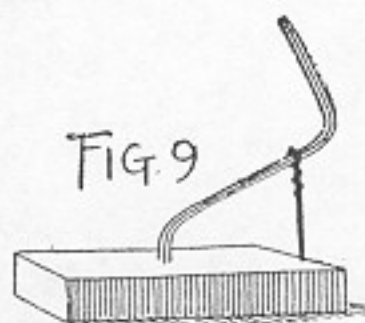
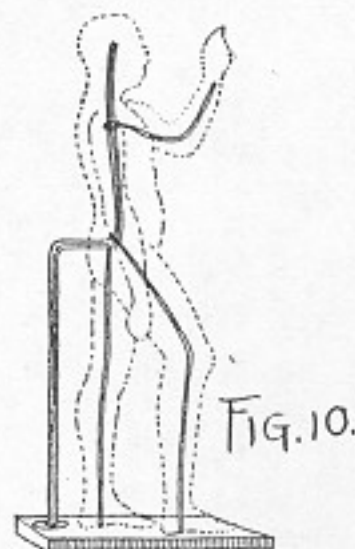
The glue mould on being removed will reveal a perfect plaster-casting that, instead of being solid, is hollow, and in consequence is much lighter.

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Modelling a Foot

To model a foot from a plaster cast, as shown at Fig. 7, it will be necessary to lay or putty up the form in the rough, as suggested for the bust in Fig. 2. Now rough out the form with the modelling-tools, so that it will appear as shown in Fig. 8. A frame, or support, should be made from a block and a stout piece of wire, as shown at Fig. 9, so that the mass of clay, particularly that at the back of the foot, will not settle.

For full-length figures it is always necessary to construct



a frame after a rough front and profile drawing has been made. With this drawing in sight, it will then be a comparatively simple matter to construct a wire or iron pipe frame such as that pictured in Fig. 10.

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Bas-relief Modelling

Bas-relief work is another interesting department of clay-modelling. This is one-sided in its effect, and the full, rounded appearance of the statue or bust is reduced to a more flattened form with lower relief. A familiar example of bas-relief is the head on a silver dollar, or the raised ornament on silverware and pottery. Let us now begin with the group of pears and leaves illustrated in Fig. 11.

A small block or piece of wood is treated to a coat of shellac or paint; then the clay is puttied on to roughly form the parts in the group. With the modelling-tools the outline and form is gradually worked out; then the surfaces are smoothed down, and the few little artistic touches given here and there to lend life and character.

Bas-reliefs can, of course, be cast any size, and from the original plaster mould many duplicates in composition or *papier-maché* may be made.

Garlands, festoons, sunbursts, panel ornaments, and cartouches can be modelled in clay, and afterwards cast for architectural features in interior decoration. A good example of the garland is shown in Fig. 12. This is made up of flowers and ribbons, and with careful and patient work the boy sculptor should be able to obtain results quite as pleasing in detail as that illustrated.

A Medallion Head

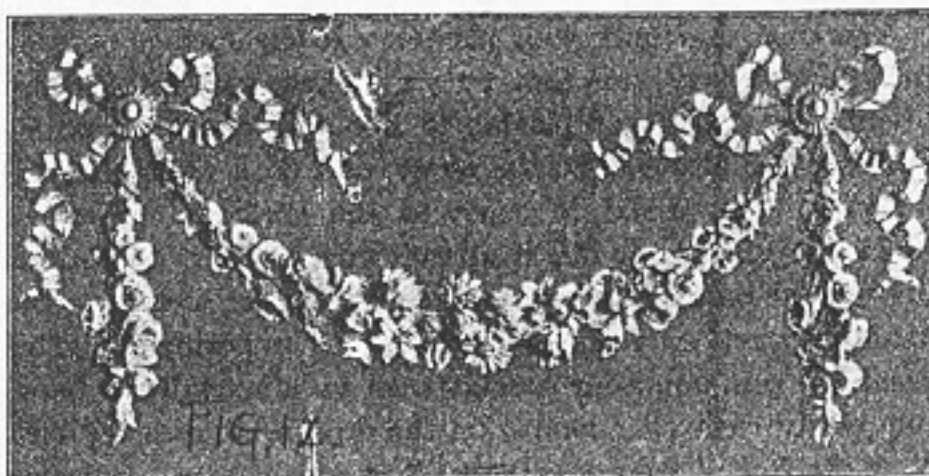
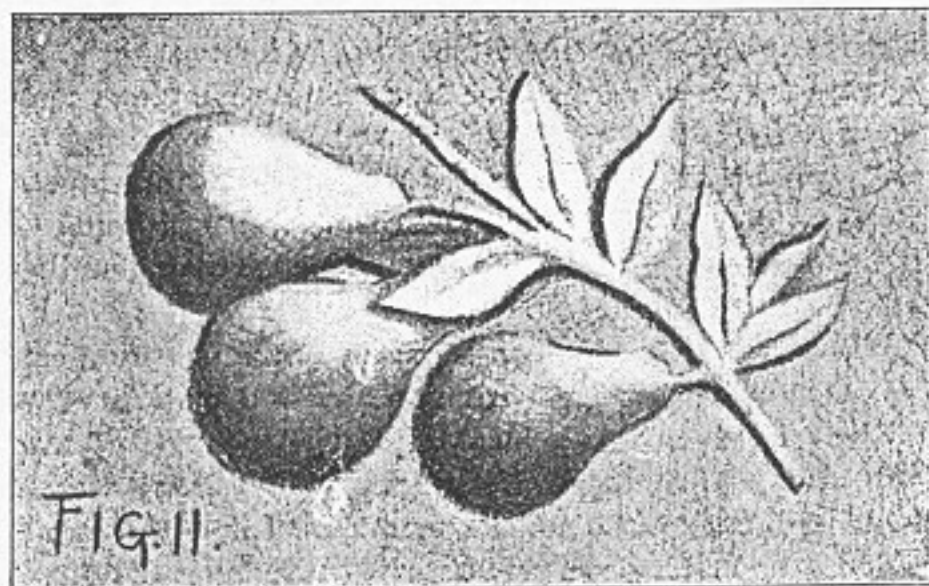
After some experience in casting ornaments in bas-relief has been obtained, it would be well to try a head or bust.

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A simple method of doing this is to take an ordinary school slate and make the outline of a head on it. Within this outline you build up roughly with your finger and thumb a cake of clay about half an inch in thickness; then with your modelling instruments work it up as accurately as your artistic skill will permit (see Fig. 13).

When in the progress of your work you find it necessary to leave it for a short time, be careful to cover it over with a wet cloth, and if for a long time, put two wet cloths over it, and cover them in turn with a sheet of newspaper. This is necessary to keep the clay from getting hard and unfit for working. If at any time you find the clay getting too stiff, sprinkle it with water shaken from a whisk-broom. To make the moulds of your clay model you will require a little plaster of Paris, some lard oil, and some soap, and then your outfit is complete.

When your clay medallion is finished, build a wall of clay around it of about an inch and a quarter in height, as shown in Fig. 13; then get a teacupful of lard or olive oil, and add to it a good teaspoonful of any kind of soap scraped fine. Put this on the stove and stir until it is thoroughly



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mixed; then with a soft camel's-hair brush lay a slight coat over your entire work.

You must now mix your plaster. If the surface of your medallion is, say, one foot by six inches, you will require about two pounds of plaster to about a quart of water. Sprinkle the plaster into the water, and then watch it until bubbles have ceased to come to the surface. When no more bubbles appear, stir it up well with a stick. The mixture should be about the consistency of thick cream. The exact proportions you must find out by experiment. This plaster cream you pour quickly over your medallion, blowing gently with your mouth on the fluid as it spreads itself over the face of your work; this is to prevent the formation

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of bubbles. In a short time the plaster will become hard; you then remove your clay wall, and lift the plaster mould, or matrix, from the clay. This you do by passing a penknife all round between the plaster and the slate, after which it lifts easily. You have now a perfect plaster mould. If you find any small particles of clay adhering to it, wash them off with a soft camel's-hair brush and water.

You now want to get a plaster cast from your matrix. To do this you lay a coat of the soap and oil mixture with a camel's-hair brush all over the face of the mould, and then pour in the plaster just as you did before, taking the same precautions to blow upon the plaster and to build a wall of clay around the mould.

You let this stand for half an hour until it is perfectly set, when you can remove your casting by passing a thin-bladed knife all round between the matrix and the casting.

If it does not then lift easily, plunge the whole thing in water for an instant, after which you will have no difficulty in separating the two parts.

You now have a plaster cast of your original work, which you can touch up and finish off with sand-paper, or with the blade of a penknife if necessary.

You can, of course, make as many casts as you please from your mould, and thus have very pretty little souvenirs to present to your friends.

Coin and Metal Casts

This same procedure may be employed when making moulds and casts from coins, medals, and medallions. A

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FIG. 13



FIG. 14



FIG. 16



FIG. 15

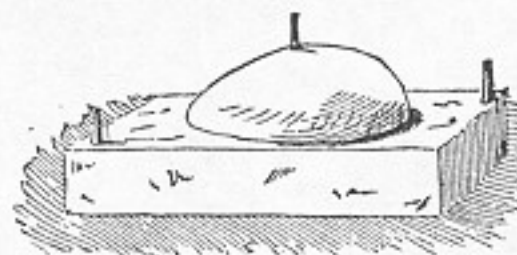


FIG. 17

MEDALLION AND PLAIN CASTING

narrow frame is made of wood, and at the middle of this a medal is placed on the flat oiled surface of a board, a slate, or a piece of marble, as shown at Fig. 14. The face of the object is now prepared with the oil, and the plaster is poured as previously described. If any number of reproductions are to be cast from the mould, it would be well to give it one or two coats of thin shellac; then oil it before each impression is made.

Plaster-casting in General

It is not a difficult matter to reproduce in plaster almost any object that has no undercut or parts that will not easily detach from a mould. When making them, the first thing to do is to get a piece of board about a foot square; that is to work on, so as not to soil the table. Then you want a lump of clay about as big as a football, five or six pounds of plaster of Paris—it only costs three cents a pound—and a half-dozen wooden pegs. You also want a cup of warm melted lard, or Castile soap dissolved in hot water, to rub over what you are going to copy, so as to prevent the plaster sticking to it.

Now, suppose it is an egg you want to copy. You rub it all over with your melted lard, and lay it down on the piece of board. Pack clay around it as high up as the middle of the egg, and as far out as half an inch from the widest part. You must be particular about not putting clay higher than the middle, because, if you get the clay too high, you can't get the egg out without breaking the mould.

When you have the clay around the lower half of the

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model, smooth and level it, and push two pegs in opposite corners, as shown in Fig. 15. Now around the whole thing make a box or case of clay, with sides rising half an inch higher than the model (Fig. 16). Mix plaster of Paris and water together till you have it like molasses on a warm day; pour that into the clay box, so that the model is covered, and the mixture even with the top of the box.

The plaster will set, or become hard, in a little while, and you then tear the box away, and take out the model and plaster together, leaving the first clay mould. Next put the plaster mould and model in a clay box just as you did before, and pour plaster over it, first greasing the model and upper surface of the mould. Before pouring on the plaster, roll a small piece of clay in your fingers, and put it on the model (Fig. 17), so that when you pour plaster over it, a hole will be left in it through which you may pour plaster for the final cast.

For the second time tear away the clay box, and gently separate the two parts of plaster of Paris; take the model out, and you will have two blocks of plaster, which, when brought together, will contain an exact mould of the model (Fig. 18), and one block will have an opening in it through which you can pour plaster. Before pouring in the plaster, however, be sure to grease the insides of the mould. Then put the parts together, using the pegs and holes as guides to a proper fitting, and tie firmly with a piece of twine. Now pour the plaster in, and then shake the mould gently in order to make the mixture settle in all the smaller crevices.

Of course when you separate the parts of the mould now you will have a perfect cast of your model. It will have a

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thin ridge running around it where the mould was joined, but that is easily rubbed off with sand-paper.

In a mould made from a hand you proceed in about the same way. The great thing is to find the dividing line in the model; that is, the place where the parts of the mould ought to join. In the egg it is easy enough, for you can divide

FIG 18

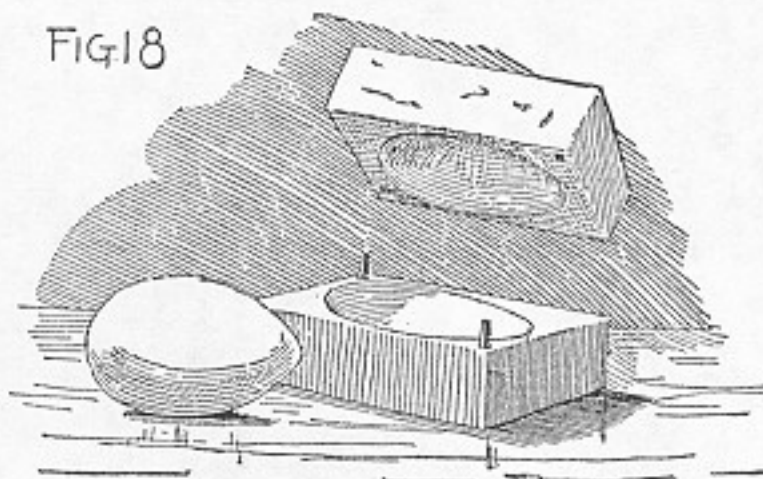


FIG 20

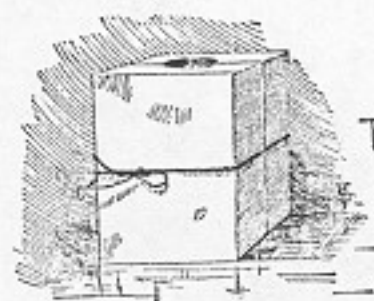
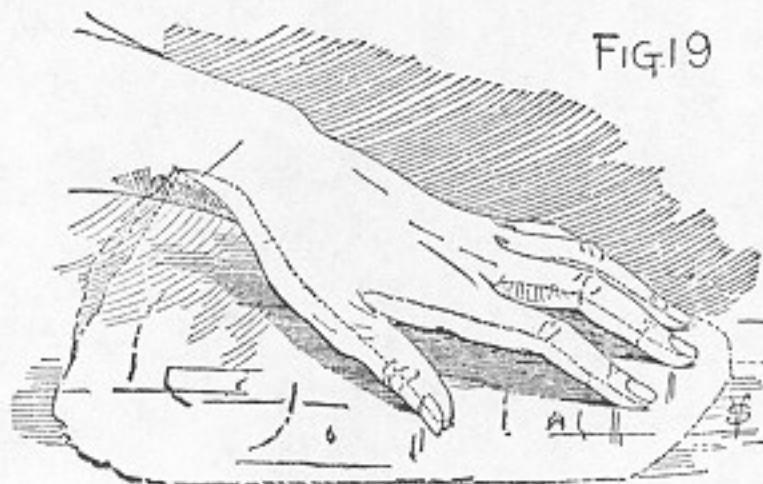


FIG 19



PLASTER-CASTING IN GENERAL

it into two equal parts; but you take a hand, and you have to make the line around each finger just where it is broadest (Fig. 19), and build the clay up to that line. The wrist-hole in a hand-mould makes a good hole to pour the plaster in (Fig. 20), and, after all, a hand is easy to make.

These simple directions should make it easy for the amateur modeller to acquire the first principles of the art. There are several good compositions in which the young craftsman can work besides plaster of Paris, such as "Kiln Cement," "Carton-pierre," "Papier-maché," "Plaster Compounds," "Artificial Marble," and "Concrete."

How to Find and Mount Signets

There is nothing prettier or more attractive, hanging on the walls of one's parlor or chamber, than a group of signet impressions in sealing-wax of various colors, artistically arranged and handsomely mounted; while the pleasure to be derived in seeking them is quite as keen as that which the coin or stamp hunter enjoys, without the expense attached to them, for our seals cost comparatively nothing. The outfit is simple, consisting of a dozen sticks of sealing-wax in different colors—black, brown, red, gold, white, and green, making a charming combination with any

other shades that take the fancy of the collector. A light wooden or strong pasteboard box to carry the articles, a box of matches, a white taper (cut in half for convenience' sake), and, later on, a piece of stiff white card-board (16×22 , 22×28 being good sizes) to mount them on.

Keep in the bottom of the box containing the wax a dozen or more pieces of thick, white, unruled writing-paper cut into ovals, circular, oblong, and square shapes, varying in size from one-half inch in width to two inches in length. This is all that is required. Now for our hunt. As you meet friends and acquaintances, notice their rings and watch-charms. When any are discovered with a figure, crest, handsome monogram, or initial on it, borrow it, and make your impression. This is accomplished by laying a piece of your writing-paper, at least half an inch larger than the seal to be used, on some smooth surface like a table. Then take a stick of wax between the thumb and forefinger of the right hand; with the left hand a match or taper, and bring them together: just on the paper where the wax melts sufficiently to drop freely. Rub the end of the sealing-wax quickly over the middle of the paper. Then moistening the seal with the tongue to prevent the stone adhering to the burning wax, press it firmly into the hot bed prepared for it, a second or so, being careful to lift it straight up when taken off, thus securing a clean edge. If this is properly done a fine impression of your subject is secured. Repeat this operation several times, taking different-colored wax for duplicates, which will enable you to make exchange with other collectors, who are unable to get these same figures, but have others not in your collection.

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Chapter XII

PYROGRAPHY

PYROGRAPHY, or fire-etching, is by no means a modern art, but one that was practised many centuries ago both in civilized and barbarous countries. In Europe, during the early ages, this work was executed with a poker inserted in the fire and heated red hot; but as the iron must have cooled quickly, the task of embellishing a panel was a tedious and laborious one.

A knowledge of drawing will be very helpful to the young pyrographer, as the object can be sketched in lead-pencil and followed with the heated iron or platinum-point.

Of the various materials that may be used on which to etch the ornament, wood and leather have been found the most satisfactory, since they retain the deep, rich brown-and-black tones given by the heated iron, and yield more readily under the tool than other materials.

If wood is employed, such as oak, birch, maple, holly, and cherry, it should be selected with a pretty grain and as free from knots as possible; but if leather is used, a good quality of oak-tanned sole-leather will give the best results; although for light work a pleasing effect can be had by employing a stout Suède and etching on the rough side.

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The etching-tools are few and simple, and are shown in the illustrations.

Fig. 1 depicts a set of irons that can be made by a boy from pieces of round iron a quarter of an inch in diameter

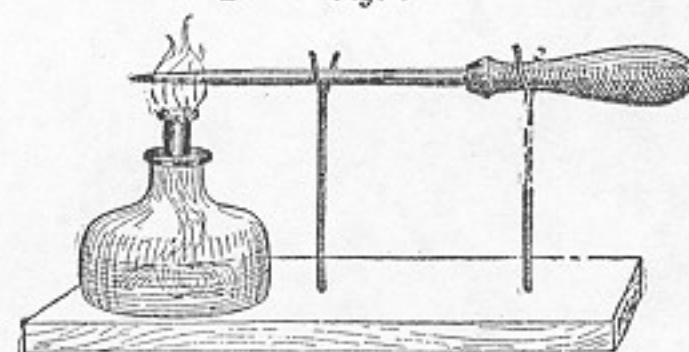
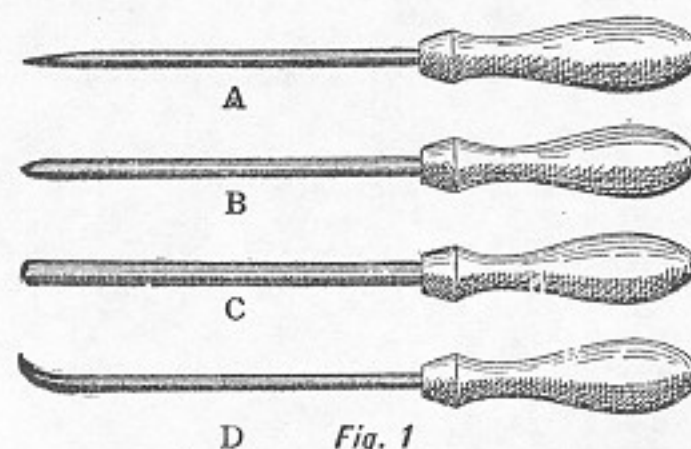


Fig. 2

and having the points fashioned with a file. The ends of the irons can be inserted in file-handles that may be purchased at a hardware store for a few cents each.

A is a sharp-pointed iron for outlining; B is a round-pointed one for broader work; C is a stub for bold work, and measures three-eighths of an inch in diameter; D is a

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curved background tool, and is used for burning in the grounds, or shading, in order to make the design stand out boldly.

With these tools and a spirit-lamp and rest, such as is shown in Fig. 2, some very good work can be done; and to complete the set a sharp-edged eraser may be added to scrape away the wood, if perchance it should have been touched by mistake with a hot iron.

To begin with, it is best to carry out a simple design—to decorate a panel, a drawer front, or the sides to a small wooden box. The pattern must first be drawn out in full size on a piece of smooth brown paper, and then transferred to the face of the wood by the use of colored or black transfer-paper, sheets of which can be had at an art or stationery store for a few cents each.

To reproduce the design, lay the transfer-paper face down on the wood, and over it the drawing face up; pin it fast, and go over all the lines with a lead-pencil, bearing down to impress them on the face of the wood. Having gone over all the lines, unpin one corner and raise both sheets of paper to see that the impression is good. If not, replace the paper and redraw the faint or unmarked lines.

Fig. 3 is a simple and attractive design for the embellishment of a panel, of a small drawer, or as one of the sides to a box.

If the tools shown in Fig. 1 are used, fill the spirit-lamp

half full of alcohol and light it, then place the pointed iron A on the rest in such a position that the point will be enveloped by the blue flame, where, after remaining a minute, it will become red hot. Remove it and trace the lines in the

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wood with the hot point until all of them have been gone over, and as a result the wood will have the appearance of Fig. 4. The iron will necessarily require reheating continually, and to save time it would be well to have two or three irons of each shape, as they cost but a few cents, and are easy to make.

After the outlining has been done, the background should be burned in with the curved iron D. Fig. 5 illustrates the



Fig. 3



Fig. 4

manner in which this may be accomplished; the left side is partly finished, and shows the simple and effective mode

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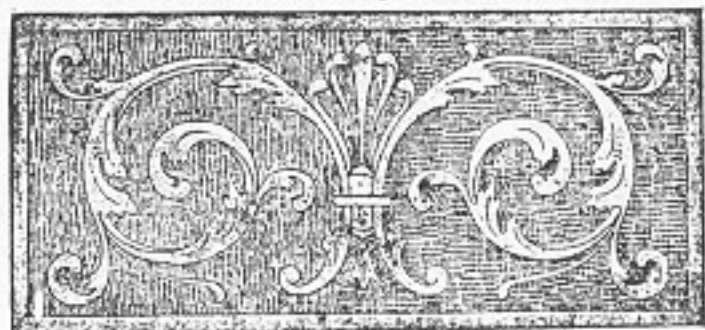


Fig. 5

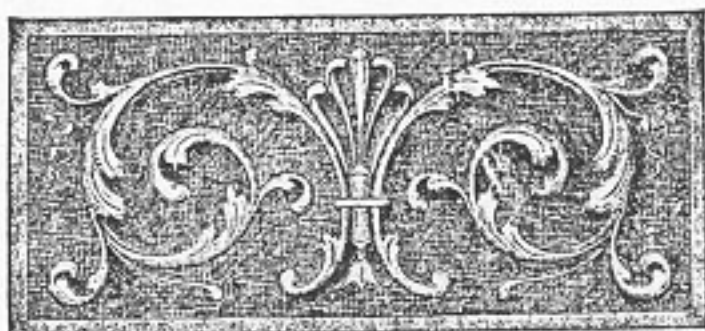


Fig. 6

of lining or "dragging" the ground. The right side is a finished ground, where the cross-strokes may be seen with an occasional oblique stroke to lend added density. It is

not always possible to complete a ground until the ornament is shaded, and what may seem to be a finished background before the shading will sometimes afterwards prove too weak or flat, and will necessarily require going over in places to strengthen and darken it.

Fig. 6 is a piece of finished work where the ornament is shaded to give it character, and where also the background

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has been retouched in some places to give it a stronger feeling. This illustration is a good example of pyrography, and gives the relative tones of high light and shadow.

Before beginning on an ornamental piece of work, it would be well to practise on clear pine or white-wood, and to become dexterous in the use and manipulation of the tools, and to find the ones best adapted to certain kinds of work. The round-pointed tools B and C, shown in Fig. 1, are good grounders, and where large work and bold patterns are carried out they will be found of use.

As some very fine work is possible in fire-etching, the art can be applied in many ways to decorate pieces of useful and ornamental furniture about the house.

Charming pictures can be produced on holly and white mahogany; designs of fruit and flowers and conventional patterns may be applied to panels, tables, screens, frames glove and handkerchief boxes; and on maple bedroom furniture designs in pyrography lend a pleasing and artistic appearance.

When working on leather do not cut out the form until after the work is finished, but pin the material flat on a board to hold it firmly while operating with the hot irons.

The entire design should be drawn on the face of the leather with a soft lead-pencil, and afterwards gone over with the burning-points. When the work is completed the piece of leather should be removed from the board, and the outline cut with a sharp penknife or a pair of scissors.

It may be desirable to varnish and polish some specimens, and it is possible to do so by coating the surface with a thin spirit varnish or thin furniture polish. This will bring out

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the density of the burned lines, and enrich a design that on certain woods might seem flat. Too much varnish must be avoided, and only a very thin coat will be necessary to obtain the desired result.

A Platinum-point Outfit

In preference to the hand-made irons, which must be heated each time before using, the modern devotees of the fire-etching art use the gasolene lamp and platinum-point apparatus. These outfits may be purchased at the art shops for a comparatively small sum, but the young craftsman may want to make his own apparatus. With the exception of the platinum-point and its metal holder, this is quite possible.

The parts of a gasolene outfit are the bulb, rubber tubing, platinum-point and handle, reservoir-bottle, metal union-cork, and a spirit-lamp. The latter may be purchased at a drug or hardware store for a few cents; but a good-working

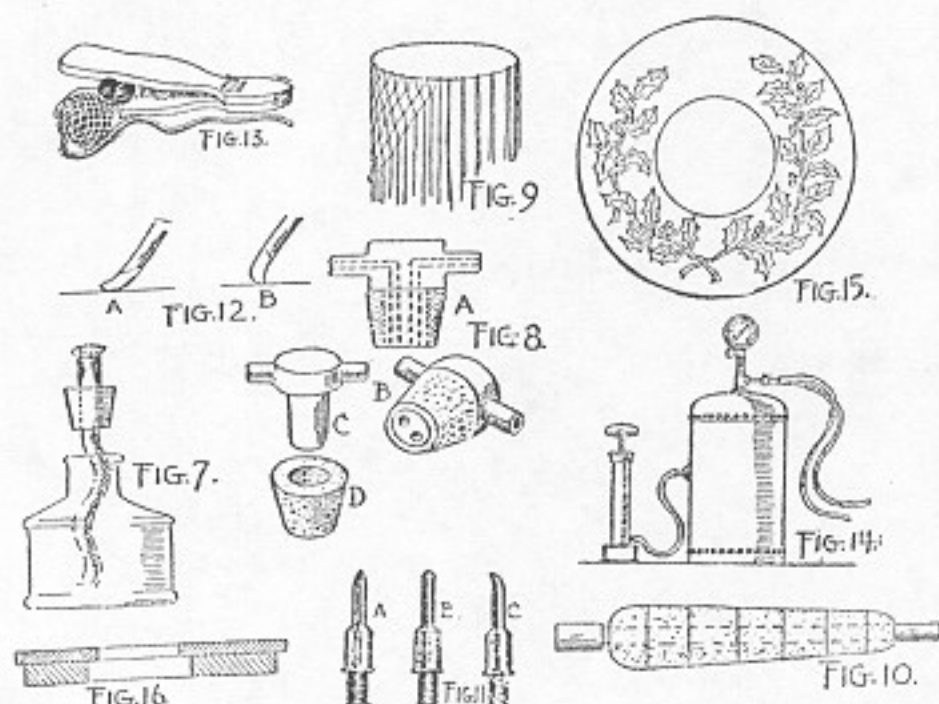
one can be made from a square or round bottle, a cork with a hole through it to receive a piece of brass tubing, and a piece of round lamp-wicking. (See Fig. 7).

Heat a piece of wire red hot, and burn a hole through the cork large enough to slip in a piece of brass tubing a quarter of an inch in diameter. Pass the lamp-wick through the tubing, and allow an inch or two of wicking to rest at the bottom of the bottle. This lamp should be filled half full of alcohol, and it is used to heat the platinum-point at first; after that the rush of gasolene vapor will keep the tool red hot. The gasolene reservoir is a square bottle with a fairly large neck into which is fitted the metal union-cork. If it

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is not possible to purchase this cork, then one can be made as shown at B in Fig. 8.

From a solid piece of lead one and a half inches long, three-quarters of an inch wide, and one and a quarter inches deep,



cut a lug, with a knife and file, having two projecting ears as shown at C in Fig. 8. The lower part is half an inch in diameter and three-quarters of an inch long. With a hot iron burn a hole in a cork so that the lower end of the lug will fit within it, as shown at D in Fig. 8. With a small drill bore a hole in the end of each ear. These holes should run through towards the middle of the lug, taking care, however, not to bore too far, since the holes must not meet.

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Bore two holes up through the lower part of the lug so that each will meet one of the holes bored through the ears, as shown by the dotted lines at A in Fig. 8. By this construction the air forced through a tube connected with one ear travels through that ear and down into the bottle; then up through the other hole and out at the opposite ear, where another tube is attached that leads to the platinum-point. The end of an old syringe can be used for the supply bulb, and for the pressure bulb there is nothing better than the inner bladder of a football, if it can be provided with an extra tube so that air may be forced in at one end while it is escaping at the other. This rubber balloon can be inflated to twice its normal size if care is taken not to blow

it up too large. As a precaution against its destruction, it would be well to make a protective net from cotton string with a small mesh. This is easily done by making a wire hoop the diameter of the bladder when blown to its safe size; then loop cotton string over it, as shown in Fig. 9, and tie the knots forming the meshes as shown at the left side of the same drawing. Continue the work until a cylindrical net is formed about three or four inches longer than the size of the inflated bladder. With a draw-string the open ends of the net can be drawn together after the bladder is placed within it. The outlet of the bladder is connected by a rubber tube to one ear of the cork, and another tube leads from the opposite ear to the platinum-point and holder.

The holder is simply a piece of brass tubing at one end of which a coupling is made fast. This tube is pushed through a cork handle, or the covering can be made by burn-

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ing holes through corks and slipping them over the tube, at the same time using thick shellac to act as a glue and hold the corks to each other and to the brass tube. The cork covering should be heavier near the point end, because the tube becomes hot from the superheated platinum-point. This handle should be three-quarters of an inch in diameter, and gradually tapered to half an inch at the back, as shown at Fig. 10. The brass tube should be five inches long and the cork handle about four inches in length. Half an inch of the tube projects beyond the back, or top, of the handle, and over this end a piece of rubber tubing is slipped. A complete outfit should contain three points—one sharp, one round, and one curved. These can be purchased at almost any art store, and should appear as shown in Fig. 11, A being the sharp point, B the round one, or grounder, and C the curved, sharp-ended point that is used for fine work and light lines in shading or background.

A good platinum-point can be bought for one dollar and a half; but better ones will cost all the way from two dollars to five. If a boy has points B and C in his outfit, he can do some very good work; but should it be possible to have one only, then the curved point C should be the choice, since with that tool almost everything can be done.

The principle of the gasolene pyrographic outfit is very simple. The reservoir-bottle is filled half full of gasolene, or benzine (62°), which can be had at a paint store for twenty-five cents a gallon. The union-cork stopper is then pushed down, and the platinum-point screwed in place at the end of the handle. Light the spirit-lamp and hold the platinum-point in the flame until it is cherry-red; then

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squeeze on the supply-bulb and fill the pressure-bag. The air forced through the first section of rubber tubing goes down through one hole in the cork, picks up some gasolene vapor from the reservoir-bottle, and passes along the second section of tubing to the point, where it escapes through a very small hole at the side. Directly the vapor reaches the flame it ignites, and the hot point is kept in its heated state so long as the pressure of the bulb forces the gasolene vapor

out through the hole.

Do not bear hard on the wood when working. The heated metal will char the wood easily if gentle pressure and several strokes are used. Points A and B (Fig. 11) can be used on all sides and on end, but point C should be used only on its curved edge, as shown at A in Fig. 12; never as shown at B.

When both hands are needed for the work of holding the material and tool, a convenient foot device can be made, as shown in Fig. 13. This is a pressure-jack made from two boards, the upper one being cut and hinged, as shown in the drawing. The boards are twelve inches long and three inches wide, the short end of the top one being attached to the bottom plate with glue and screws. The wood should be three-quarters or seven-eighths of an inch thick, and it may be given a coat of shellac or varnish to improve its appearance.

If a constant supply of air-pressure can be had without the bothersome hand or foot bulbs, it makes it so much easier to master the art of pyrography.

Any ingenious boy who has a foot pump, such as are used for bicycle or automobile tires, can get an old boiler from a

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plumber and rig up a pressure-tank such as is shown at Fig. 14. A small pressure-gauge should be screwed fast on top of the boiler, and two outlets with brass cocks should be constructed out of one-eighth-inch gas-pipe, the fittings being purchased at a gas-fitter's or a supply house. By means of the pump compressed air can be stored in the tank, and the pressure will be registered on the gauge. Twenty to twenty-five pounds will be quite enough pressure for an old boiler, although sixty pounds is the standard to which most of them are tested when new. The advantage of the two outlet-pipes will be appreciated when working, because each can lead to a different sort of point, and this will save the time and bother of changing points frequently for different parts of the work.

The Practice of Pyrography

Basswood, deal, and white-wood are the material most commonly employed for this work, since the grain is close and the color even. Almost any soft wood, however, can be used, and the boy who has mastered the craft of carpentry can make his own boxes, frames, stools, chairs, and miscellaneous wooden objects, and then embellish them with designs drawn in lead-pencil, the lines of which it will be an easy task to follow with the hot platinum-point.

Small picture-frames can be made from one piece of wood, but they are better, and will last longer, if made from two pieces. For a small round frame a pretty pattern is shown in Fig. 15. This can be made from six to twelve inches in diameter, and the frame proper should be from two to four

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inches wide, having an opening for the picture from two to four inches in diameter. The easiest way to make a frame is in two pieces, as shown in Fig. 16, the left

side representing a narrow frame and the right a wider one.

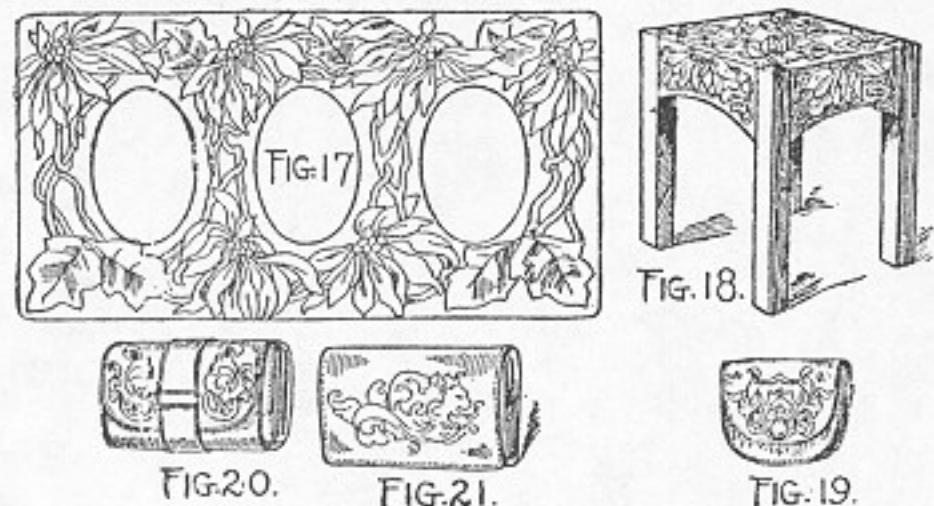
From holly or basswood one-eighth or one-quarter of an inch thick cut a disk six inches in diameter, and at the middle cut an opening three inches in diameter. Strike the circle with a compass; then use a fret-saw to do the cutting. From pine or white-wood half an inch in thickness cut a disk five and a half inches in diameter and at the middle a hole four inches in diameter. Lay the thin disk down on a table, and after applying glue to one surface of the smaller but thicker disk place it, glue-side down, on the larger disk, taking care to have the grain of the two pieces run in opposite directions. See that the disks are adjusted so that one is centred directly over the other; then impose a piece of board on top of the frame, and put fifteen or twenty pounds of flat-irons or other heavy weights on the board to press the two wood pieces together. Leave them for several hours; then remove the weights and clean off the hard glue that may have oozed out from between the disks. Give the back of the frame two coats of shellac to prevent the wood from absorbing moisture, and it will then be ready for the design and the pyrographic ornamentation. By using the two pieces of wood, a rabbet is thereby formed for the glass and picture. If the frame had been made from one piece it would have necessitated the cutting of a rabbet. The design of holly leaves and berries is a pretty one, and quite simple to draw and burn.

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A Few Suggestive Designs

A long picture-frame with three oval openings is shown in Fig. 17. This is made from two pieces of wood, as described for Fig. 15, and then embellished with the design and pyrographically treated.

In Fig. 18 an idea for a stool is shown. This little piece of furniture can be made of white-wood by the boy who has



learned to handle tools. The legs are two inches square and fifteen inches high. The side-boards are each twelve inches long, four inches wide at the ends, and three inches at the middle; they are arched or crowned, as shown in the drawing. Blocks of wood are glued and screwed to the inner edge of each end, and these in turn are made fast to the upper parts of the legs. The top is sixteen inches square,

with the corners cut out, so that it will fit down on the top
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of the side-rails and between the tops of the legs. Strips of wood three-quarters of an inch square should be glued and screwed to the under side of the seat at the four sides, and these in turn must be made fast to the top inner edges of the side-rails.

Leather-work

When embellishing leather, select the quality that is best adapted to pyrography. It must not be too thin, as the hot point would quickly perforate and cut it. Cowhide, Suède, calf, sheepskin, heavy kids, and binding leathers are best adapted to this work. Purses, bags, mats, boxes, travelling-rolls, and valises are made in leathers that are admirably adapted to pyrography, and these should be purchased rather than made, for leather-working is a craft that would not interest the average boy.

An heraldic pattern for a small pigskin or cowhide purse is shown in Fig. 19, and Figs. 19, 20, and 21 are designs adapted to different kinds of purses, wallets, and bill-books. It is, of course, impossible to lay down any specific sizes for these patterns, as the sizes of leather goods vary.

To improve the appearance of floral patterns, it is desirable to tint or stain flowers, leaves, berries, and stems in their natural colors. This can be done on the unfinished wood, either before or after the outlines and background are burned. Oil or aniline stains may be used for this purpose. If a dead finish is desired, the wood can be left without further treatment, except for a thin coat of bees-wax and turpentine. If a glossy finish is preferred, the wood must be treated to several thin coats of white
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shellac; then a finishing coat of white dammar-varnish is applied and left to dry for several days. The inside of boxes should be "grounded" and shellacked, and at the top and bottom pads made of card-board, cotton-filling, and silk should be glued fast.

Chapter XIII

BOOKBINDING AND EXTRA-ILLUSTRATION

THERE must be many boys who would like to know the simple methods of binding books, so that they can do it without the aid of machinery or costly tools. They are probably aware that when the material of a book comes from the hand of the printer, it consists of a number of large sheets that are commonly twenty inches long and fifteen broad. Eight pages of the book are printed on each side of a sheet in such a peculiar order that when the sheet is properly folded the pages will be correctly arranged by the numbering. To see how this is, take a sheet of paper that measures fifteen inches by twenty. With a ruler and pencil draw lines across the sheet so as to divide it into eight equal parts. Each of these parts is a page. Number them as shown in Fig. 1. Turn them over and number the pages

on the other side as shown in Fig. 2. Now to fold the sheet, lay it on the table with the side up that has on it 2, 15, etc.; bring page 3 over upon page 2, creasing the sheet in the middle. Then the four pages lying upward will be numbered 4, 13, 12, 5. Bring page 5 over on page 4, and crease in the middle again. Pages 8 and 9 will now lie upward. Fold 9 over on 8, and the sheet will be folded as it should be,
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and is now called a signature. In a book there may be twenty or thirty, or more such signatures, which are numbered so that the binder will know in what order to place them. These numbers are placed at the bottom of the first page in each signature.

The Tools

Before beginning the work of binding, a few preparations must be made, and first of all a press is indispensable. This is very easily made. Take two pieces of board, of some close-grained hard-wood, about one and a quarter inches thick and a little larger than any book you are likely to undertake to bind. Eighteen by twenty inches will be found the most useful size. Lay your boards together, and with an inch auger bore through both three holes at each end of the boards about an inch back from the edge. Now

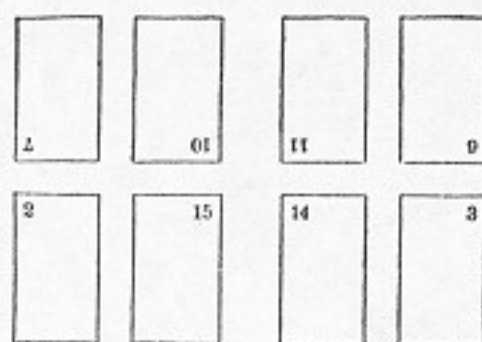


Fig. 1

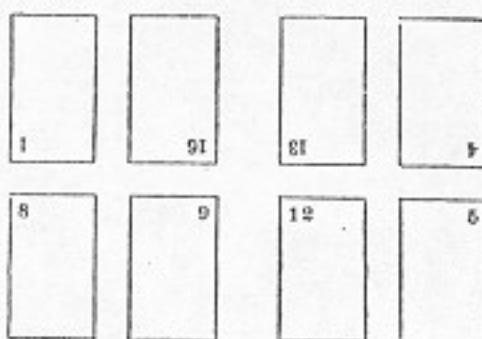


Fig. 2

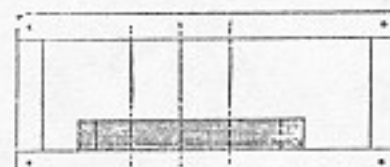


Fig. 3

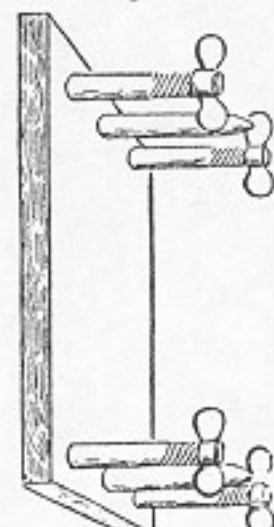


Fig. 4

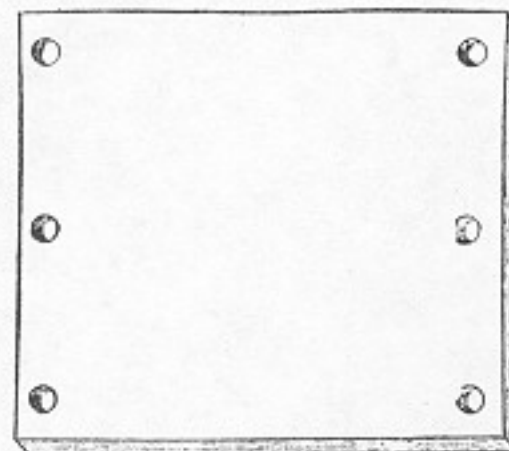


Fig. 5

make six pegs of hard-wood—white oak is excellent—about six inches long, and fit them tightly into *one* of your two boards, on one side of it; that is, the pegs should all stand out at one side. (Fig. 4.) When this is done, carefully work down the size of the pegs until they will pass freely through the holes in the other board, so that the two boards may be separated or brought close together as required. The loose or movable board (Fig. 5) should be fitted with a backstay or two, so that it will stand edgewise on a table, and the two boards together will thus form a sort of upright press or vise.

In order to furnish your press with power, you must now pass four large iron "wood-screws" loosely through the blank

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outer edge of the movable board into holes in the corresponding edge of the other board, where they should "bite." When a book is put into the press it is a very easy matter to tighten the screws so as to hold it firmly. This simple, inexpensive, and easily made press may be improved in various ways; screws with winged nuts may be used, etc., but in its simplest form it will be found sufficient for all the demands the amateur binder is likely to make on it.

Next in importance to the press is the hammer, and this is the only tool you will be likely to have to buy. It should be heavy, weighing at least twelve or fourteen pounds, and should be rounded at the ends. This is used for beating and compressing the books, shaping their backs, etc. If you live near a foundry it is quite easy to make a model of wood or clay and have a hammer cast. In any case, it is not an expensive tool—any blacksmith can hammer one out in a short time.

The glue-pot may be almost any little crockery dish, but it should never be put on the stove. If you have no regular glue-pot, you can melt your glue in an old cup placed in a saucepan of boiling water.

Besides the press, hammer, and glue-pot, you must have a pair of scissors and a few simple but sharp-cutting tools. When these things are all prepared you are ready to bind your book.

The Practice of the Art

After removing everything that is not to be included in your volume, place the "signatures" or parts together in regular order, striking the backs gently on the table or bench

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to get them even. Then place them on a block and beat with the hammer so as to flatten and compress them as much as possible. Then they should be put very carefully into the press and the screws tightened firmly, so as to hold the volume steady. The back should project about one inch above the edge of the press. Now, with a common handsaw, cut four slits across the back at regular intervals, not deeper than the teeth of the saw. Take the book from the press, and into each of these slits or nicks lay a piece of stout cord or twine (not too thick), and to these cords all the signatures forming the book must be fastened with pack-thread. A necessary aid to this sewing process is a small

square frame of light wood. The cords must be tied to this below and above, as shown at Fig. 3, and the lower part of the frame must be sufficiently broad and flat for the book to lie upon it. After the cords are laid into or passed through their respective nicks, you must open the leaves regularly and find the middle of each signature, and then pass, with a needle, the pack-thread along the inside, but twisting it around each cord in succession as you go along, making it fast at the end with a hitch or knot. This is much easier than it sounds, and with a little practice may be done very quickly. When you have finished the sewing cut away the cords, leaving an inch and a half or so on each side, which is left to make the attachment to the cover. This completes the first stage of the binding.

The book must now be replaced in the press, and its back covered with a good coat of glue melted in the manner already described. Leave it in the press until the glue is thoroughly dry. In the mean time measure the breadth of

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the back and go ahead with the preparation of your cover, which may be made as follows:

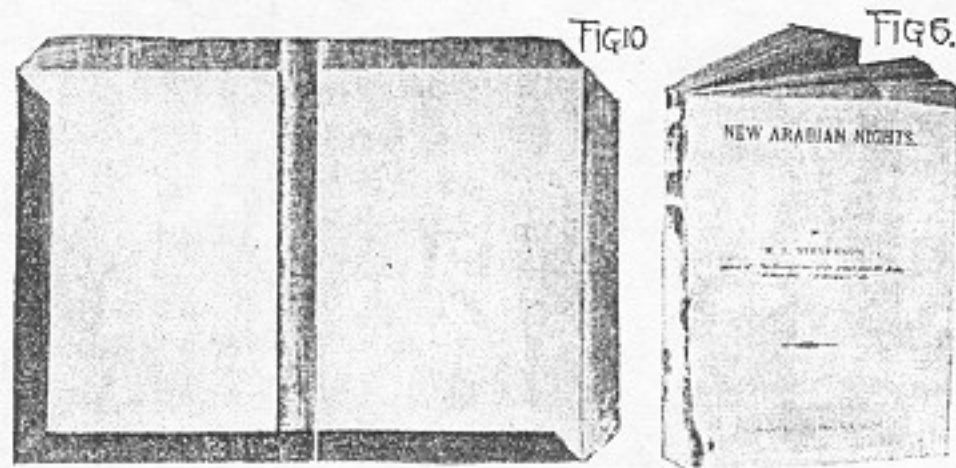
Cut two pieces of thin pasteboard a little larger than your book. Also cut a piece of cloth—calico, linen, or muslin—so much larger than both pieces of pasteboard either way as to allow for the back and the turning in. Down the middle of this paste three or four strips of the same goods to strengthen the back. Carefully measure the length and breadth of the back, and lay your pasteboard covers on the table, leaving the space of the back between them. Now put on your cloth, turning it around the edges of the covers, carefully avoiding creasing or wrinkling, and lightly glue it fast as shown at Fig. 10. Your cover is now made and must be allowed to dry. Next take your book from the press, unravel and soften the projecting ends of the cord, and wet them with strong glue. Lay the book down carefully on its back into the cover and glue down the cords to the sides. The book should be supported in this position, which can be done in any number of ways, and a slip of cloth glued down over the cords to hold them steady. Then paste over all this a sheet of white or fancy paper to line each cover, and when the job is dry your work is done.

Nothing has been said about cutting the edges of the book, as that is usually done on a machine; but if you are able to trim them clean with a sharp knife, so much the better. To do this, place the book into the press before putting on the cover, bringing up each edge of the three exposed ones successively, and while held there firmly, cut them carefully with a sharp knife or shoemaker's cutting-tool. Any little inequalities may afterwards be taken down with sand-paper.

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The edges when cut may be spattered with any color desired by using a common tooth-brush and water-colors.

To put on the title in gilt letters, the binder applies a little of the white of an egg over the space where the letters are to be. When this is dry, rub the leather with a rag slightly greased, and then lay on the gold-leaf. Next take common type used by printers, heat them a little, and stamp



on the letters. The heat makes the gold-leaf stick where it is wanted, and the rest is rubbed off with a rag. All the gilt ornamentation on book covers may be put on in a similar manner.

To get a clear understanding of these directions the boy craftsman should examine different kinds of books very closely; and if he has an old and valueless one he can take it to pieces and put it together again. Perhaps he can improve its condition. At least he will learn some of the minor details. He must remember that in bookbinding, as in all other arts, patience and repeated trials are requisite

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for acquiring the skill that produces neat and handsome work.

Rebinding Books

It is not always possible for a boy to purchase cloth-bound volumes of his favorite authors, as they cost quite a little money. But he may often procure them in paper covers, and if he is careful to select stitched books, rather than those simply caught together with wire or "wire sewed," as they are termed, it will be possible for him to rebind them in cloth at a slight expense.

To begin with, strip off the paper cover, taking care not to tear the printed title on the cover, nor that at the back of the book, if it is possible to save it. Both of these will be useful in the rebound volume. With a penknife and sandpaper remove as much as possible of the paper cover that has been glued to the back of the book, taking care not to cut away any of the stitching; otherwise the book would fall apart. The book in this condition, ready for its "case" or cover, is shown in Fig. 6. If the signatures have been caught together with wire, remove the latter with a pair of pliers; then sew the pages as already described. Get two pieces of white paper the same thickness and quality of which the book is made, and fold them over once, as shown in Fig. 7. With paste or liquid glue attach one at each side of the book by running the paste along one side of the folded edge of paper for a quarter of an inch, as shown by the shaded line in Fig. 7. This is called "tipping," and where a page or two have become detached or not properly bound in, this method is employed to reset it.

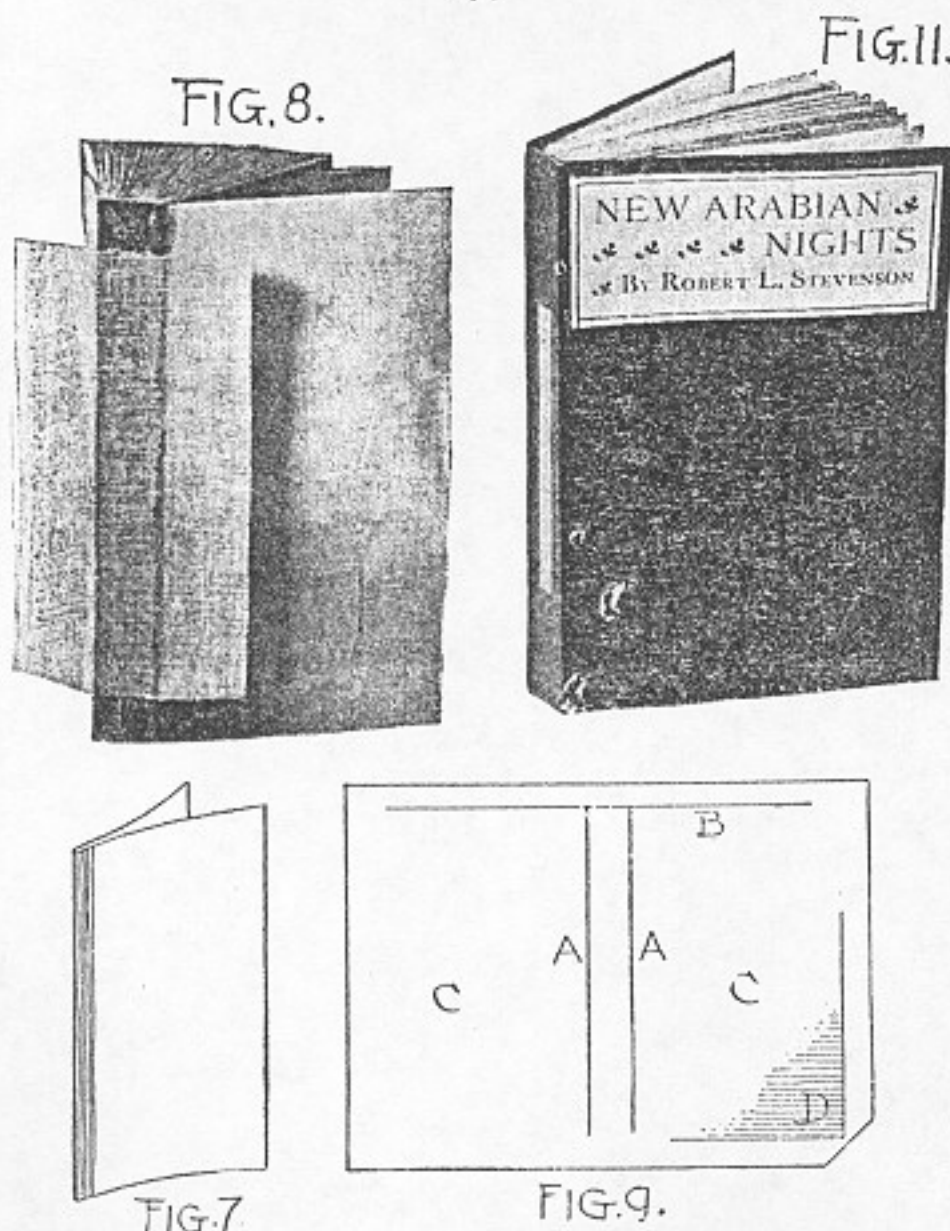
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When these pages are in place, trim them so as to correspond to the size of the book; then glue the back of the book well and attach a piece of crash to the back as shown in

Fig. 8. The crash should be a trifle shorter than the height of the book, or about half an inch at each end, and there should be at least an inch of the material on either side of the book, as shown in the illustration. This material is known as "crash" in the book-binding trade, but it is nothing more than a coarse-thread cloth with open mesh, and it is sold in dry-goods stores under the name of crinoline.

From clay-board or stiff card-board, binders' board, or strawboard, cut two pieces an eighth of an inch wider and a quarter of an inch longer than the actual size of the book. These are for the front and back corners. Lay the binding material—buckram, cloth, or leather—on a table or smooth board face down. Now, with a lead-pencil, mark two parallel lines through the middle, as far apart as the thickness of the book plus the thickness of the covers, as shown at A A in Fig. 9. Then mark a line across one end at right angles to these, as shown at B. Apply glue to the covering material and place the card-boards on the spaces C C, so that the inner edge and top of each board will line with the pencil-marks A and B. Press the boards down with the fingers; then turn the cloth and boards over and press with a dry cloth, rubbing over the surface to drive down the cloth; in any place where it does not seem to have adhered. With scissors or a knife cut off the corners as shown at D, taking care not to approach too close to the corner of the boards. Leave about one-eighth of an inch of cloth beyond the

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REBINDING AN OLD BOOK

corners, so that it will cover them when the edges of the cloth are turned over. These edges should be about half an inch in width. After applying glue to them, lap them over on the card-boards, as shown at Fig. 10, and rub them with the soft cloth to drive out all air from between these edges and the boards.

When the four sides are finished, the cover or case is ready to receive the book. Lay the case open on a table, just as you see it in Fig. 10, and apply glue to the space between the card-boards, and also on the card-boards for an inch or so from the inner edges. Now take the book in hand, and place it so that the back will rest on the space of cloth between the boards, leaving an equal projection of the cover above and below the board, or about one-eighth of an inch. With the fingers press the projecting flaps of crash down on the glued surface of the cards at either side of the book; then lift both covers up to the sides of the book (still allowing it to rest on its back), and with both hands press the covers together as hard as you can. Hold it in this position for a few seconds; then carefully lay the book on its side and place a flat-iron upon it for five minutes.

At the end of this time carefully lift one cover and apply glue or paste to the first fly-leaf (that is one of the pages you tipped in), and press it against the inside of the cover, taking care, however, not to allow the paper to wrinkle. Turn the book over and repeat this on the other side; then replace the flat-iron and leave the book under pressure for a day or two; or, better yet, arrange it in between the pressure-boards described for Figs. 4 and 5, and leave it there overnight.

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If the first page has adhered to the glue about the edges of the crash, it will be necessary to carefully pull it away, taking care not to tear this first page or lining sheet, nor to disturb the crash. If liquid glue is used, it will not set hard enough in the five minutes to render it impossible to remove the paper. If hot glue is employed, it will not be necessary to close the book and press it, for the glue will set very quickly, and the first and last pages may be pasted and laid over the inside of the covers at once, so that when placed under pressure and left there the crash, glue, and paste can set and dry at the same time.

The object of pasting the blank pages to the inside of the covers is to make a good finish to the binding, and also to lend additional strength to the attachment of book and case. Fancy end-papers and richly tinted or colored ones are often used as linings, as you can see in many books. These are always tipped in as described, so that they will be the first and last pages in the book.

From the paper cover (which you removed from the book before binding it) cut the title, and, with glue, apply it to the front cover near the top, as shown in the illustration of the finished book (Fig. 11). If the back title has been preserved that can be pasted along the back.

How to Extra-illustrate a Book

Every one knows how much more interesting is an illustrated book than one without pictures. What a satisfaction it would be to us if we could illustrate our favorite books ourselves! What pleasure we would take in it! This

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is entirely possible. It is a comparatively easy matter to illustrate a book, or, in the case of a book that already contains pictures, to extend and increase the illustration by means of old prints, engravings, and pictures gathered from various sources, and bound in with the leaves of the book. This is called "extra-illustrating," and has long been a favorite amusement of collectors.

A book that is carefully and judiciously extra-illustrated is not only much more attractive in appearance, but its value is greatly increased, and the amount of pleasure and instruction to be gained by the extra-illustration of one book is a rich reward for the trouble and time it costs.

The first thing to be done in the extra-illustration of a book which has been selected for the purpose is the collection of the pictures. This will often take some time, and should never be done in a hurry. Old magazines and illustrated papers will supply many of the necessary pictures, while old books and the shops devoted to the sale of old prints and engravings will furnish others.

Suppose *The Three Musketeers* to be the book chosen. A portrait of the author should be selected for a frontispiece. Other portraits, representing the author at different ages, may be used in the book; but that which serves as the frontispiece should be one made about the time he wrote the book.

The other illustrations should consist of pictures referring as nearly as possible to the scenes and incidents described in the story. Pictures of an author's home or portraits of members of his family are always useful; but no picture, however interesting in itself, should be included if

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it does not bear directly upon the scenes in the book, or is not in some way connected with the author.

When a sufficient number of illustrations have been selected, they should be mounted ready for binding. This is the difficult part, and must be done with great care.

Take a sheet of strong paper, as nearly as possible the same color and weight as the paper upon which the book is printed, and cut it the exact size of the page of the book. Then trim your print close to the work, being careful to see that the edges are perfectly straight. Cut out from your sheet of paper a hole exactly the shape of the print, but an eighth of an inch smaller on all sides. This opening should not be exactly in the middle of the page, but a little above the middle and a little to the left, so as to give wider margins at the bottom and on the right. Now gum or paste the edges of the print on the under side with great care, and place it over the opening so that it is even on all sides. As there is a difference of only a sixteenth of an inch on the four sides, it is a delicate matter to place the print on the mount accurately, but after a little practice it can be done quite easily and quickly.

After the prints are mounted, they should be pressed until dry. Then the cover of the book should be carefully removed with the aid of a sharp knife. Never mind about ruining the blank pages or fly-leaves, for they will be replaced by the binder when he puts the cover on again; but care should be taken to avoid cutting or tearing any of the printed pages. When the cover is removed, it will be found that the book is put together in sections laid one on top of another. These sections consist of sixteen or some other

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number of pages each, and a section is known in a printing-office as a "signature." The threads that sew the book should be cut, and the signatures should be carefully separated from each other.

Then the mounted prints should be laid in as nearly as possible opposite the incidents they illustrate. The prints should always be inserted face up, and the sidewise full pages with the bottom of the picture towards either the outside or inside margin of the book. Now your book is ready for the binder. Perhaps your extra-illustration has been so extensive as to increase the bulk of the book so much that the original cover will not go on again, and perhaps enough has been added to make the one volume into two, in which case your binder can supply you with simple covers at a very slight expense.

Books of travel, or stories of hunting, fishing, etc., may be beautifully illustrated by photographs. Unmounted prints are to be desired, although it is possible to take prints off mounts by a liberal soaking in warm water. The soft-finished photographs, such as bromide and platinum prints, are vastly better than the shiny albumen prints.

Photographs should be mounted in the same way as other prints, except that no openings are to be made in the mounts. The prints should be pasted on flat and pressed until dry. Albumen prints have a tendency to curl up, and it will require a pretty stiff paper to keep them flat. This is one of the reasons why platinum or bromide prints are so much better. When albumen prints are used they must be mounted wet, and should afterwards be burnished, which can be done by any professional photographer. An

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amateur photographer can have the fun in many cases of making the pictures himself for the book he wants to extra-illustrate, and the finished work will have an added interest and value to him.

The use of photographs, especially if many are included, will greatly increase the thickness of a book, and it will generally be found advisable to have the binder make it into two volumes of equal size.

A Circulating Library

In a small town, or in a residential section of a city where most of the young people are acquainted with one another, a circulating library may be formed at a nominal cost. This can be done in two ways: the first plan is for the members to contribute the books—from one to ten volumes—as may

be agreed upon. Many people hesitate to lend books, because they "fly off and never come home to roost," but by the circulating-library system law and order can be maintained. One of the most successful libraries of this kind was carried on for a number of years in a New York town. The young people, in due time, became married men and women, but through the association of the library they continued to hold together like a great big family.

A regular set of by-laws were established and lived up to. Books could be drawn each week, on a day set for this purpose. A librarian was selected, and in his house the bookcase was located. There were three locks on the case. The key of one was held by the librarian, another by the president, and the third by the secretary and treasurer. Regu-

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lar dues were assessed on each member—twelve cents a year at first; then fifty-two cents, and finally one dollar. Books kept over two weeks were charged for at the rate of one cent a week, doubling each week for four weeks. This fine made it imperative for the subscribers to return books at the end of three weeks or suffer a heavy penalty.

Another popular scheme was carried out by the children in the Glenwood section of Greater New York. They held a fair some years ago, and made quite a little money. They then purchased paper-covered books by good authors and rebound them in cloth. A bookcase was constructed that held over one hundred volumes, and the same co-operative plan was inaugurated that has just been described.

Chapter XIV

MAGIC LANTERNS AND STEREOPTICONS

BOYS who have cameras, and who have made good collections of views, portraits, and other interesting pictures, may find a great deal of pleasure in entertaining friends with stereopticon exhibitions of their work. The necessary plates and materials may be purchased at any camera or photographic supply store, and with a little patient practice excellent lantern slides may be made. A good magic lantern or stereopticon is a luxury, but for the ambitious boy there is a way to make one at home with but little outlay of money beyond the cost of the lenses and lamp.

A Home-made Magic Lantern

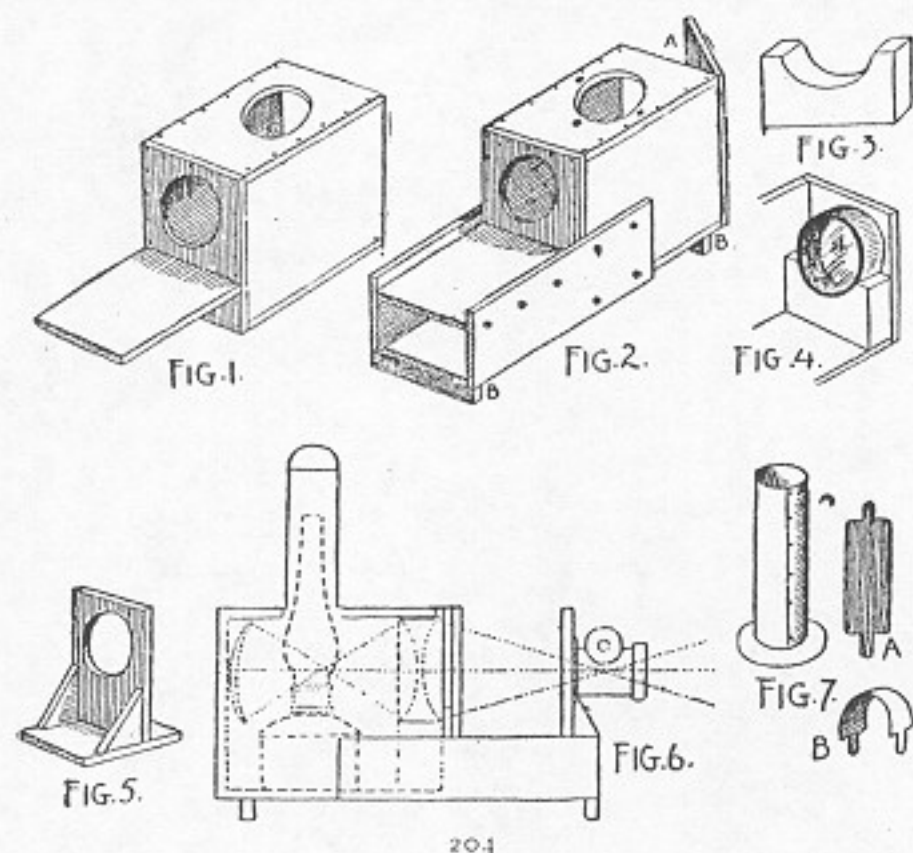
A box, some thin boards, an ordinary central-draught or duplex-burner lamp, a reflector, some nails and screws, a pair of condensing-lenses, and a projector are the materials necessary.

Make a box of half-inch wood, twelve inches long, eleven inches high, and seven inches wide, outside measure. Cut a round hole four and three-fourths inches in diameter at the front of the box, the middle of the hole being eight

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inches above the inside bottom. Make a door at the back of the box, and fasten a reflector just opposite this hole.

Cut a hole in the top of the box for a lamp-chimney to come through. Nail a piece of half-inch wood eight inches long to the front of the box three inches from the bottom (see Fig. 1). We will call this the deck. Fasten a piece of wood fourteen inches long and four inches wide on either side of the box and deck-piece (see Fig. 2). Perforate the bottom of the box with holes half an inch in diameter, to afford the necessary draught to the lamp. Elevate the box on two cross-sticks an inch wide (see Fig. 2 B B).



From an optician or camera supply house obtain a pair of four-inch condensers mounted in a brass barrel, and a quarter-size projector with a rack and pinion. Mount the condensers in the hole in front of the box, supported by means of a block (Fig. 3), fastened on the inside front of the box (see Fig. 4).

In order to adapt the focus of the lenses according to the distance the lantern is from the screen, a sliding front is necessary (see Fig. 5). Cut a base-block scant seven inches wide and six inches long, fastening to it, three and one-half inches from the front, an upright piece of wood high enough to be even with the top of the lantern-box. When the base is resting on the deck in front of the box two small angle-brackets will steady the upright and make it rigid (see Fig. 5). Cut a hole in this upright board so that the centre of the projector mounted in it lines exactly with the centre of the condensing-lenses. This is an important point; if the lenses are not carefully mounted opposite one another the picture will not be clear. Now fit a piece of wood one-fourth of an inch in front of the main box, fastening it at the top with a strip of tin. There must be a hole three inches square cut in this board, the middle of which must line with the centre of condensing-lens. In the opening between this board and the box slip a thin piece of board for the slides to rest on. Set a double-wick lamp or central-draught burner within the box at the proper height, so that the brightest part of the flame will be in direct line with the centre of the reflector and the condensing-lenses.

The principle of the magic lantern is the reflection of the light through the condensing-lenses, which pick up all the

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light possible and throw it through the slide, which is located directly in front of it. The light is then taken up by the projector, and the pencils of light are thrown onto the screen, at the same time magnifying the picture. This principle is shown by the dotted lines in Fig. 6, which show also the relative position of the lamp, lenses, and reflector.

To keep in the light that would escape through the top opening in the box, put a piece of common stove-pipe (small) over the lamp-chimney. Cut a cap from a piece of tin (Fig. 7 A), the ears extending down inside the chimney to hold the cap in place, when the cap-piece is bent in a half circle as shown at Fig. 7 B.

To cover the space between the lantern-top and the moving front board a piece of black cloth can be used. Or if you have an old camera-bellows it may be made fast to the back of the projector-lens board and to the front of the slide-board located close to the box. It is not necessary to have an absolutely light-tight bellows; indeed, a very good one can be made from some wire hoops with black cloth sewed to them.

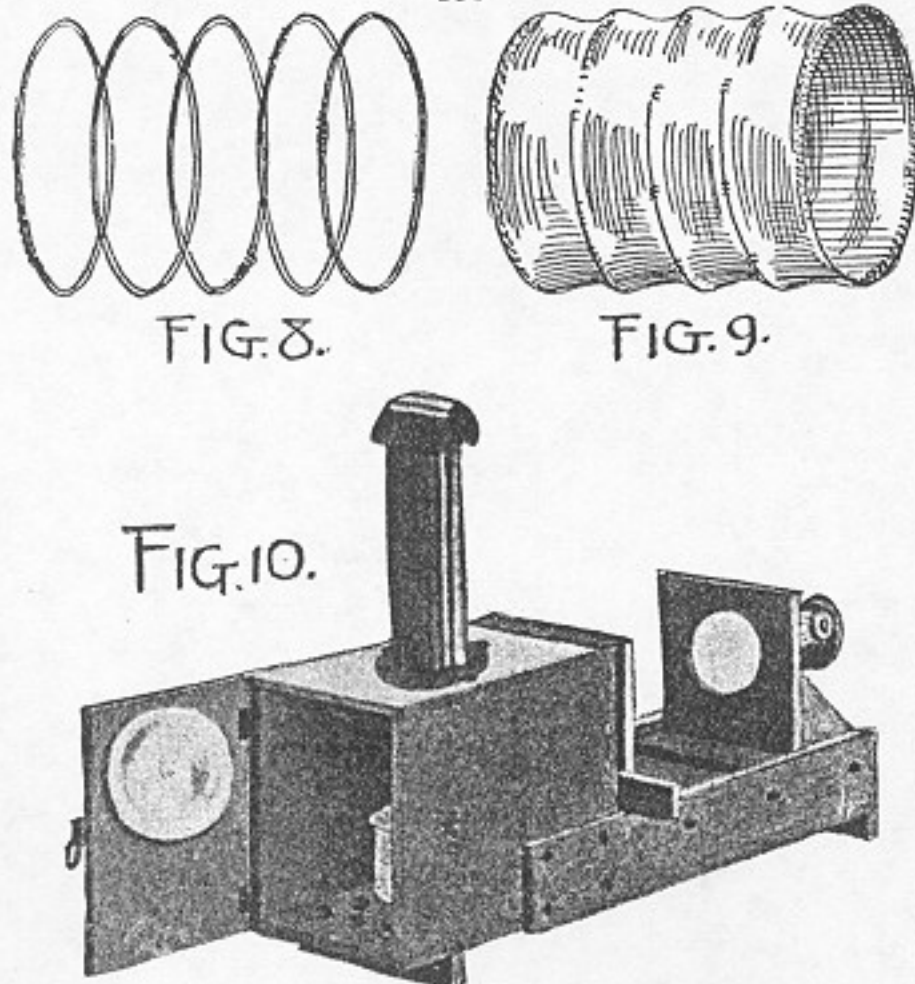
In Fig. 8 the wire hoops are shown, and in Fig. 9 the finished bellows, with the cloth stitched in place, is ready to be attached to the boards with small tacks or staples.

When all the parts are assembled, and the lantern is complete (except the bellows, which has been omitted so that the working parts may be more clearly shown), the lantern will appear as in Fig. 10.

A Stereopticon

The cost of a good stereopticon will range from twenty-five to seventy-five dollars, and that sum places it beyond

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reach of the average boy. The following instructions and illustrations will enable any smart boy, who is handy with tools and light materials, to make a high-grade stereopticon with lamp and mechanism that is capable of doing really good work.

The materials needed for its construction will be some

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sheet Russia iron, thin mahogany or cherry boards three-eighths of an inch in thickness and six inches wide, some round-headed brass screws, small hinges, a camera-bellows, and the necessary lenses and lamp. The tools include a light pair of metal shears, a fine-tooth saw and a compass-saw, a small hammer, plane, and screw-driver, and a light cold-chisel.

To begin with, obtain a board twenty inches long, six inches wide, and three-eighths of an inch in thickness to serve as the base-board. Treat this board to several successive thin coats of shellac, and rub down the last coat with fine sand-paper to give it a smooth surface. Cut another piece six inches wide, eight and one-eighth inches long, and in it make a round hole about four and a half inches in diameter, through which the case that contains the condenser-lenses may pass and fit snugly. This board is to be placed nine inches from one end of the base-board, and fastened to it in a standing position with long, slim screws driven into the lower end through the under-side of the base-board. Fig. 11 shows the arrangement of these boards, also the runners and sheet-iron hood.

From a sheet of Russia iron cut a piece nine and a half inches wide and twenty-three inches long, and have a tin-smith roll one edge over a piece of wire so as to stiffen it. With a rule and piece of chalk divide and mark off the sheet into three divisions, the end ones measuring eight and a half by nine inches and the middle one six by nine inches.

Lay the sheet on a board at the edge of a table so that a chalked line is directly over the sharp edge, and, holding it down firmly with one hand, bend the iron down with the

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other, forming a right angle. Bend the iron on the remaining line in a similar manner, and the hood is formed.

In the top of this hood, at the middle, mark off an oblong two inches wide and six inches long; then cut out the piece of iron with a cold-chisel and a hammer, laying the sheet-iron on the upturned surface of an old flat-iron. File or emery-paper the edges of the opening to render them smooth, then cut an opening in one side, three and a half inches high by four inches long, for a door.

Through the top hole a lamp-chimney may project that the surplus heat may be carried upward. For the side opening a sheet-iron door should be made and hung in place with small brass hinges, and a brass lever catch to keep it closed.

This catch is a simple little affair, and consists of a thin piece of spring brass, in one end of which a hole has been made, while at the other a little knob handle is riveted. One end is attached to the door, and to the hood beside the door a catch of thin brass is riveted fast, into which the lever catch can drop.



FIG. 12

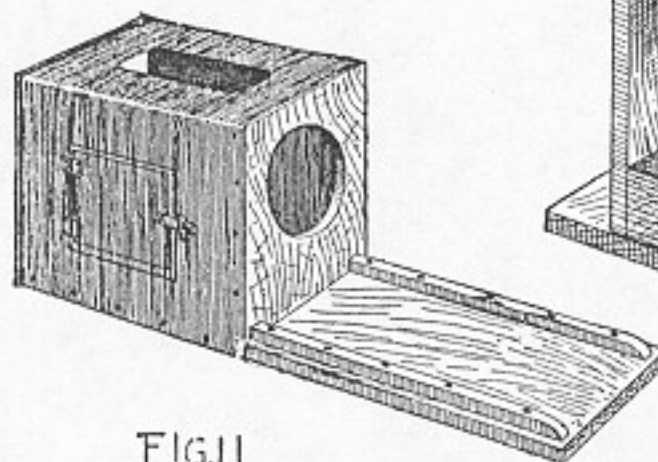


FIG. 11

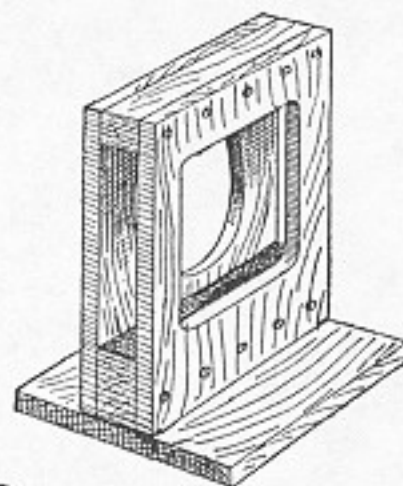


FIG. 14 A

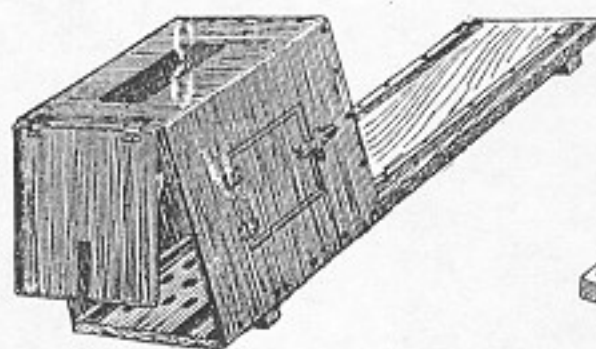


FIG. 13

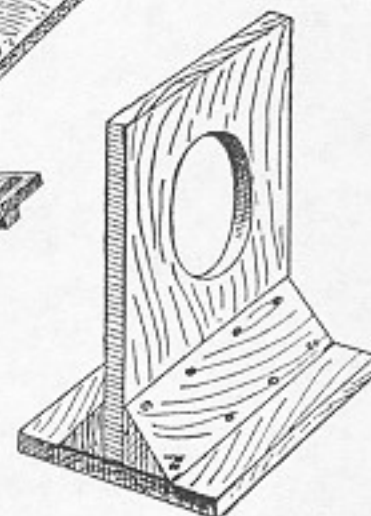


FIG. 14 B

CONSTRUCTION OF THE STEREOPTICON

To stiffen the door, the edges should be bound with narrow brass strips, securely fastened with small rivets, or escutcheon pins, that can be adapted as rivets by cutting them to the required length.

Two runners half an inch wide and three-eighths of an inch in thickness are to be screwed fast to the uncovered top of the base-board, four and a half inches apart, as shown in Fig. 11. From sheet-iron cut two strips half an inch in width and ten inches long, and fasten a piece to the top of each runner, using the same screws to hold them in place that secure the runners to the base-board. One-eighth of an

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inch of each strip will project over the inner edges of the runners, as shown in Fig. 12, and this edge will serve to hold the wooden slide-holder and objective-lens board in the proper position on the base-board.

Make a sheet-iron door six inches wide and seven inches high, with the edges rolled over a wire to stiffen them, and in the bottom of the door, at the centre, cut an opening half an inch wide and two inches high. This will allow the door to be closed over a gas-pipe that may project for a short distance from the rear of the enclosure. Attach this door to the back of the hood with two small hinges riveted at the top, as shown in Fig. 13, and across the under side of the base-board, and two inches from either end, screw battens of wood in which pins have been set. These battens will raise the lantern up from a table or box on which it may rest, and allow a draught to pass up through holes made in the

base-board inside the enclosure formed by the iron hood. These draught-holes will be necessary for either oil or gas light, and they can be bored about as shown in Fig. 13.

Two small wooden runners must be fastened to the base inside the enclosure, a distance of four and a half inches apart, and between them a lamp or gas-jet tray will slide.

From the thin mahogany cut three pieces four and a half inches wide and seven inches long. In the middle of these, and four inches from one end, make a centre dot, and with a compass-saw cut a hole in one of them three and a half inches in diameter, and in another cut a hole three and a half inches square.

In the third board make a hole the diameter of the objective lens; then with screws and glue fasten the first

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two boards together, as shown in Fig. 14 A, so that a space of three-quarters of an inch will remain between them. The height of this opening should be four and a quarter inches, and the holes in the middle of the boards should be centred. These two boards and separation blocks are to be fastened in an upright position to a narrow piece of three-eighth-inch board the same length as the width of the upright boards, as shown in Fig. 14 A; and at the outer edges a saw-cut at the joint will allow this frame to slide back and forth between the runners, so that the iron edge may fit in the saw-cut.

To the inside of the front board two springs should be attached with screws at one end of each; these springs may be shaped from corset steels, and they should be bent in a curved position, as shown at the lower end of the opening in Fig. 14 A. Their use is to hold the slide-carrier back against the rear board and firmly in place. Slide-carriers may be purchased at an optical supply house, and they are made in several shapes; the most convenient ones, however, are the sliding wooden holders that accommodate two slides.

The remaining board is to be mounted on a block and held in place by two angle strips, as shown in Fig. 14 B; and to enable it to slide between the runners it should receive saw-cuts also. Procure a camera-bellows four inches square, or in its absence employ a piece of black silk or gossamer cloth, and attach it to the frames, as shown in Fig. 16, with small curtain tacks and glue. Having mounted these boards on the base-board between the runners, the box is then ready to receive the lenses and lamp.

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From a manufacturer of optical goods purchase a pair of four-and-a-half-inch diameter condensing-lenses mounted in a tube, and a quarter-size four-inch back-focus double-objective lens mounted in a tube with rack and pinion adjustment.

The condenser-lenses should occupy the hole in the front of the box, where the tube can be firmly held in place by the inside edge of the hole. The objective lenses are to be attached to the face of the front board in the position shown in Fig 16; and by means of the sliding-board and bellows

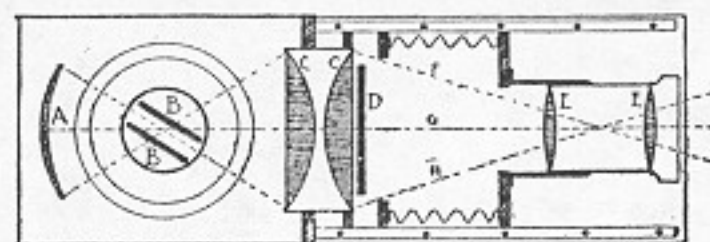


FIG. 15

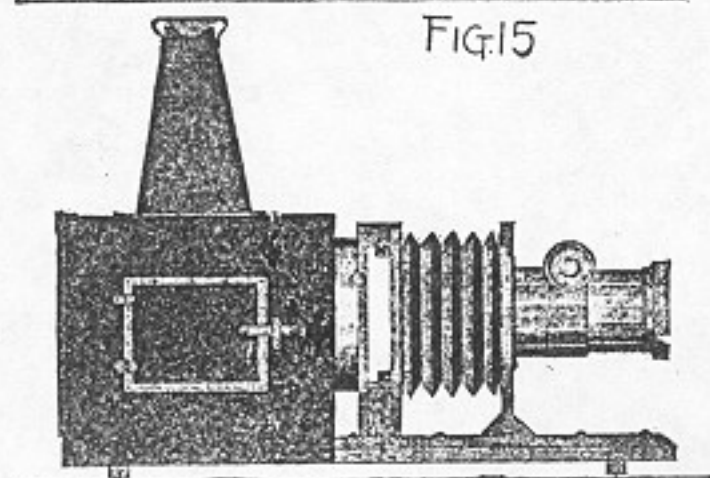


FIG. 16

the lenses can be adjusted to meet any short-focus range—

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that is, a distance of fifteen or twenty feet from the sheet on which the picture is thrown.

For use in small rooms a duplex-burner, or central-draught lamp, can be used, and a plan showing the position of lamp, reflector, and lenses is shown in Fig. 15.

A represents the reflector placed behind a lamp having duplex wicks. The centre of the reflector should be directly in line with the centre of the lenses, and the lamp must be placed so that a portion of the flame, three-quarters of an inch above the top of the wicks, will line with centre of reflector and lenses. The light is brightest in oil-lamps, from three-quarters to an inch above the wicks, and, as only a small portion of the light is of use, the most brilliant part of the flame should be employed for projection through the slide and lenses.

B B are the wicks of the lamp, and the fount should be placed so that an imaginary line drawn through the centre of reflector and lenses would pass through the forward edge of one wick and the rear edge of the other. By arranging the wicks at the angle shown on the plan, the greatest advantage can be had from the light.

The positions of the condensing-lenses are shown at C C, and D represents a slide in position at the front of them. E E gives the position of the objective lenses, and the dotted lines F, G, and H, drawn from the reflector edges crossing at the light, passing through the condensers and slides, and out through the objective lenses, show the manner in which the rays of light are collected and thrown through the transparent picture and lenses, and so on through space, until it rests against the large sheet.

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To complete the stereopticon an oval chimney is to be made, and fitted with a flange so that it may be held to the top of the iron hood with four little iron buttons or lap-hooks riveted to the top of the hood. This chimney should be four inches long by two inches wide at the bottom, and

one and a half inches square at the top, and eight or ten inches high. At the top arrange a light-cap about as shown in Fig. 16, so that the light from the lamp or gas-jet will not throw rays up against the wall and weaken the picture on the sheet.

Precaution must be taken to stop out all surplus light other than that projected through the lenses, since the useless rays tend to weaken the round disk of light on the screen, and render the picture weak and neutral in tone, instead of sharp and vigorous. The wood-work should be given two or three coats of shellac, and the iron parts should be blackened.

Dissolving views cannot be shown in a single lantern, but if two lanterns are fitted with the same kind of lenses, and placed side by side, so that the disks on the sheet are uniform in diameter, it will then be possible to obtain some very beautiful dissolving effects.

Lantern Slides by Contact-printing

Many amateurs have an idea that it requires a great deal of skill to make lantern slides, but any one who can produce a good negative can soon learn how to make a good lantern slide. The simplest way is by contact-printing.

Select a negative free from spots, scratches, or pinholes.

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It must have fine detail in the shadows, and no harsh contrasts of light and shade. The regulation size of a lantern slide is $3\frac{1}{4} \times 4$ inches, so choose a negative which will still make a good picture if all but the portion included in these dimensions is blocked out. Cover the part of the negative which is to be blocked out with black needle-paper, or paint it with non-actinic paint, applying it to the glass side of the negative. The negative is placed in a printing-frame, and then by means of a red light the slide-plate is placed over the part to be printed from, the film side towards the negative.

If one has a lantern, the light of which is suitable for printing slides, cover the negative, open the door of the lantern, and then, holding the printing-frame about fifteen inches from the light, expose from five to twenty seconds, according to the density of the plate. A plate that prints quickly will need but five or eight seconds, but a denser plate will require a much longer exposure, often as long as thirty seconds. Cover the plate as soon as it is printed, close the lantern, remove the slide from the frame, and place it face up in the developing-tray. Turn the developer over it quickly, taking care that the whole surface of the plate is covered immediately. Any developer that makes good negatives will make good lantern slides. A weak developer is to be preferred to one which brings out the image quickly. Develop till the detail is well out; wash and fix same as a negative.

As every imperfection in a plate is magnified many times when thrown upon the screen, great care must be taken in the developing, fixing, washing, and drying. When the

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slides are washed, take a piece of clean surgeon's cotton and wipe the film very gently, then place to dry where no dust will settle on the surface.

If there are any spots on the plate after washing and before drying, they may be removed with ferricyanide of potassium in solution. Tie a small piece of surgeon's cotton to the end of a glass rod, dip it into the solution, and touch the spot very lightly. Rinse the plate at once, and if the spot has not entirely disappeared repeat the operation. The ferricyanide works very quickly, and must be rinsed off as soon as applied.

Lantern Slides by Reduction

If your negatives are larger than $3\frac{1}{2} \times 3\frac{1}{2}$, and it is desired to get the entire picture on the slide, then the reduction process will have to be resorted to. For this work you can use your camera if it has a long bellows, and the work should be done in a room where a window is towards the north.

Obtain a piece of board five feet long and ten or twelve inches wide, and at one end of it erect the negative-board, as shown at Fig. 17. The negative-board or holder should be twelve or fifteen inches square, with an 8×10 rabbeted hole at the middle of it, and supported with two brackets, as shown at Fig. 17 B. Kits can be made or purchased to fit in the opening reducing to $6\frac{1}{2} \times 8\frac{1}{2}$, 5×8 , 5×7 , $4\frac{1}{2} \times 6\frac{1}{2}$, 4×5 , and $3\frac{1}{4} \times 4\frac{1}{4}$. With this range of sizes any negative from $3\frac{1}{4} \times 4\frac{1}{4}$ to 8×10 can be held in the board. Now arrange two strips of wood at each edge of the long base-

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board, so that the camera can slide forward and backward on a platform built to support it, as shown at Fig. 17 D.

The camera should be made fast to this moving platform with wood cleats and screws, and it should be mounted high enough so that the centre of the lens will be exactly on a line with the centre of the opening in the upright board, as shown by the dotted line in Fig. 17. At the upper corners of the plate-board arrange slim, steel-wire nails with the heads cut off, and bore holes near the ends of sticks three-quarters of an inch square so that they will fit down over the nails, as shown at Fig. 17 E. The other ends of the sticks should rest on the top of the camera. Over these sticks a dark cloth should be thrown when making photographs of negatives, to keep out light and prevent the high light from the window affecting the action of the lens.

To make a reduction of a large negative, fill the plate-holders with $3\frac{1}{4} \times 4$ lantern-slide plates, having obtained kits to fit your holders; then clamp a negative upside down on the board, as shown at A. Mark the lantern-slide size with a lead-pencil on the ground glass of your camera, taking care to centre it; then move your camera forward or backward and operate the bellows until the correct size has been obtained. Focus as sharp as you can; then stop down your lens with the smallest diaphragm. Experience will dictate the proper length of time for exposures. No definite

rule can be laid down, for the varying conditions of light, rapidity of plate, and state of the weather—all will have to be taken into consideration.

Lantern slides made by reduction are always sharper

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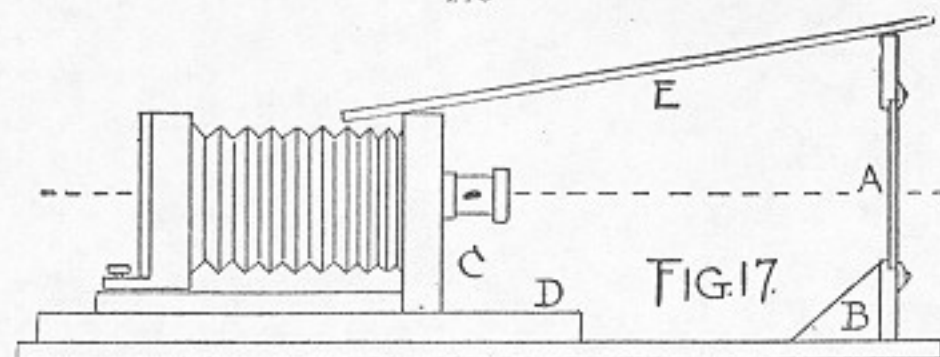


FIG. 21.

FIG. 22.

FIG. 23.

and better than contact slides, and whenever possible they should be made after this fashion, even from films which may be held flat between two plates of clear glass. A piece of white tissue-paper should be pinned against the window towards which the camera points, so that a blank white

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light will be beyond the negative, thereby avoiding the possibility of picking up any false lights or shadows.

Lantern slides should always be masked, so that the actual sight-opening through which the lantern-light is projected will be two and three-quarters inches wide and two and a half inches high. A mask form can be purchased or made from sheet-brass. The opening and the other dimensions should be of the same size as the lantern-slide plate, or $3\frac{1}{4} \times 4$ inches. The masks should be cut from black needle-paper with a rotary cutter, having first prepared a number of the blanks of the proper size; then the openings can be cut as shown in Fig. 18. A smaller mask for the central part of slides can be made two inches wide and two and a half inches high, as shown in Fig. 19, and for portraits an oval mask is the best (see Fig. 20). Covering-glasses or crystals are necessary in making slides. Old lantern slides can be cleaned and used for this purpose, or some very thin, white glass may be cut into $3\frac{1}{4} \times 4$ -inch plates.

To mount slides lay a mask against the film-side of the plate, or positive, and over this place a clean, clear covering-glass, as shown at Fig. 21. With binding-tape (which comes

in white and black) first bind one edge, as shown at Fig. 22, arranging the paper tape so that an equal margin will be visible on both sides. Bind the opposite edge, and then cut away the projecting ends of the binding. Proceed to close the short ends in a similar manner, and as a result you will have a finished slide, as shown in Fig. 23. Some slide-makers begin at one corner and run a strip of binding all around the edge without cutting it. This is a little difficult to do at first, but if you have a clamp that has a compression-screw and will turn on its axle, it simplifies matters greatly. Some amateurs prefer black binding-tape, others white. The white tape with black masks makes a neat-looking slide, and if the margin is wide enough the title of the picture may be written on it.

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Chapter XV

PRINTING, STAMPING, AND EMBOSsing

EVERY boy, at one time or another, gets an attack of printers' fever, and then he will not be satisfied until he makes or purchases a printing-press. There are, of course, many different kinds of printing-presses. One of the simplest forms is shown in the drawing of the flat-bed press (Fig. 1), which is very easy to make and to manipulate. A flat board one and one-half inches thick, twelve inches wide, and eighteen inches long will form a substantial bed on which to fasten the frame and pressure-plate. The frame is made of hard-wood strips seven-eighths of an inch wide and three-fourths of an inch high. These are glued and screwed fast to the bare board, forming an enclosure five and one-half by six and one-half inches, and large enough to accommodate a chase four by five inches. A chase is always measured from the *inside*. From one-half to five-eighths of an inch all around should be allowed for the thickness of the metal of which the chase is made.

The pressure-plate is cut from wood one and one-fourth inches thick, and the same size as the *outside* measure of the frame attached to the bed-board. A stout lever fourteen inches long is screwed and glued fast to the top of this

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board, which is then attached to the rear strip of the frame by means of three stout iron hinges, so that when closed down the pressure-plate will fit closely to the top of the frame.

The type as it is set up in the chase will stand face up in the frame, and the card to be printed is caught with gauge-pins to the inside of the pressure-plate, as shown in the drawing. The type, having been inked with the roller, gives the impression to the card when the pressure-plate is brought down and held against the type by means of the lever.

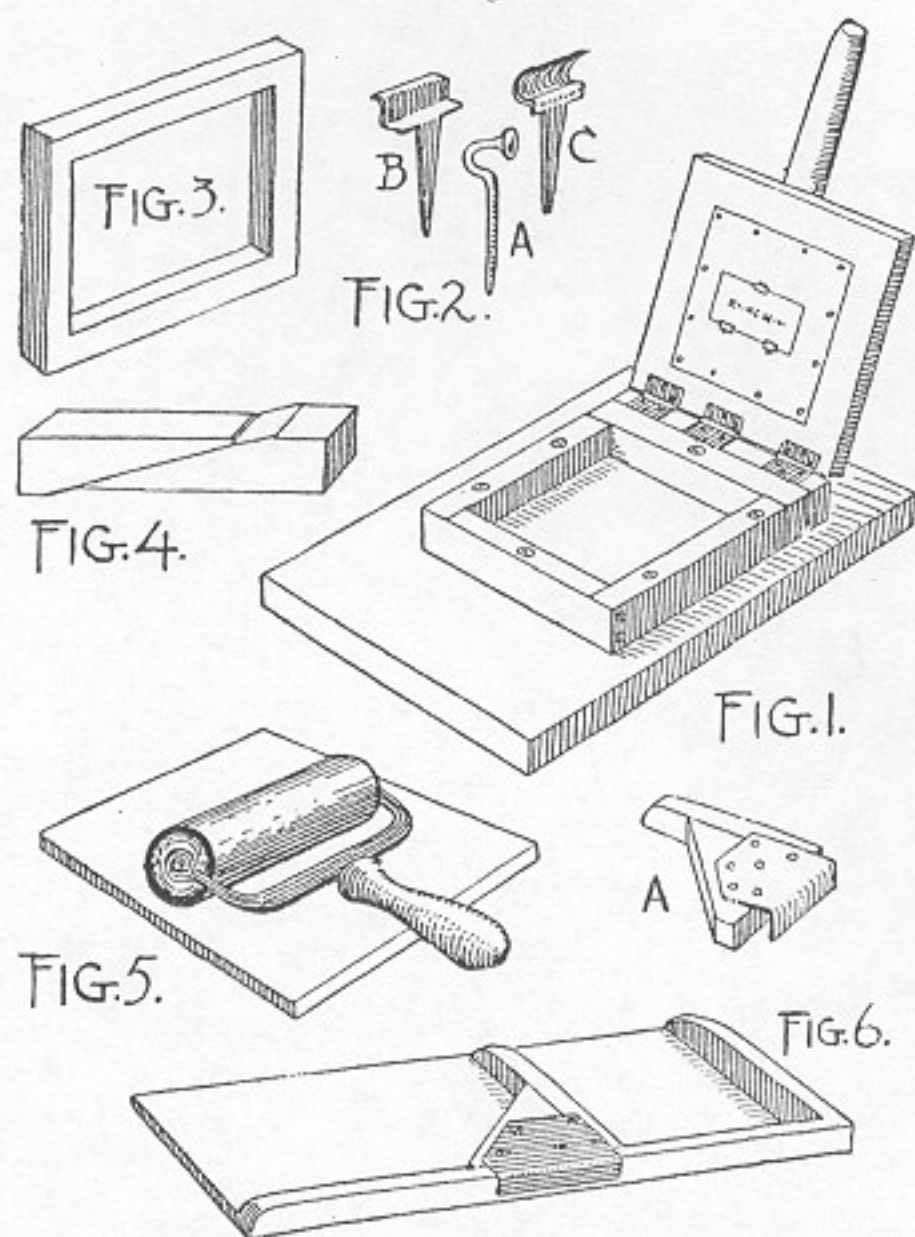
The gauge-pins that hold the card in place are made of metal or of ordinary pins. Several forms of pins are shown at Fig. 2. A is made from an ordinary pin, while B and C are other forms cut from thin sheet-brass and then bent into shape with small pliers.

Fig. 3 shows a chase five by seven inches, of cast-iron, which can be purchased at a printers' stock house for a nominal price. When the types are set up they are blocked into position in the chase, and two wedges, made with bevelled edges to bear against each other, are tapped with a light hammer on the thick ends, so as to wedge the type in place. These are called quoins (Fig. 4).

Fig. 5 shows a small proof-roller made of glue and molasses. It may be purchased at a printers' shop for a few cents.

A piece of glass or marble will answer very well for an ink-plate or slab, and after using them both the slab and roller should be thoroughly cleaned with benzine. The cleaning must be done directly after printing, else the ink dries on the roller and thus spoils it.

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A SIMPLE HAND-PRESS AND ACCESSORIES

A composing-stick (Fig. 6) may be made from thin wood three inches wide and nine inches long, with a sliding jaw (as shown at A) made of thin wood and caught to the edge with a metal strip loose enough to permit the jaw to be easily moved back and forth.

The types, being first set up in the composing-stick, are then transferred to the chase, and clamped in with blocks of wood and quoins.

An Upright Press

The upright press (Fig. 7) is on the same principle as the

flat-bed, but the chase is held in a vertical position, and the back against which it rests is braced to the base-board. This press can be made a little larger than the flat-bed, and will accommodate a chase measuring five by seven inches. At the rear of the sides of the base-board angular cuts must be made with a saw, and corresponding cuts should be made near the top of the upright board which supports the chase. With a sharp chisel cut the wood away between these cuts (Fig. 7). Cut the brace-pins also at each end (Fig. 8 A). A lap-joint is the result, and when fastened with glue and screws a firm anchorage and support is obtained for the upright board.

The pressure-plate is of wood one and one-fourth inches thick, and attached to the strip at the bottom of the upright or chase-board by means of stout iron hinges. Care must be taken when placing these hinges to arrange them so accurately that not a fraction of an inch difference is perceptible at either side or at the top or bottom. Otherwise,

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uneven pressure will give unsatisfactory results. A lever is made and attached to the pressure-plate as described for the flat-bed press, and a block may be fastened to the base-board for the lever to rest on, as shown in the drawing.

A Lever-press

A perfect wooden lever-press is shown in the large illustration (Fig. 9), which is drawn so clearly that only the

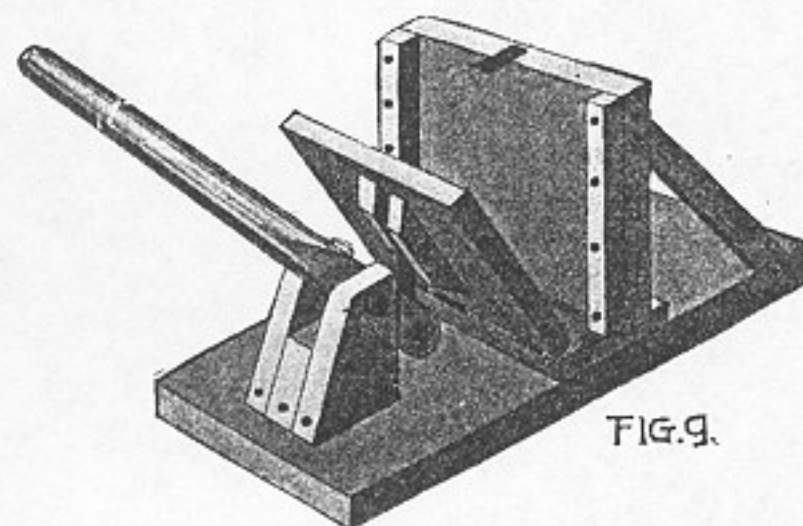


FIG. 9.

measurements will be required to understand its construction.

The base-board of this press is twenty inches long, ten inches wide, and one and one-fourth inches thick. The upright board against which the chase rests is ten inches wide, eight inches high, and one and one-fourth inches thick. The pressure-plate is the same width and thickness, but is seven inches high, and bevelled at the bottom, as

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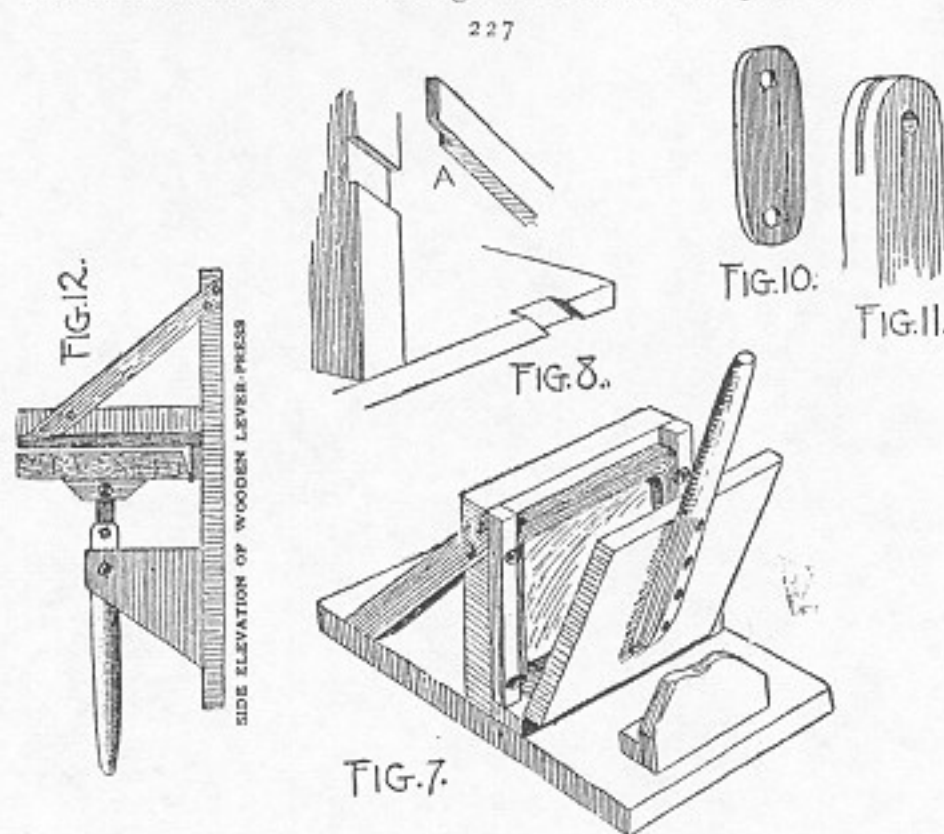
shown in the side elevation (Fig. 12). The upright board is placed six inches from one end of the base-board, and is fastened in place with screws that are driven up from the under-side of the base-board, with side-braces let in to the edges of the boards, as shown in Fig. 8.

The pressure-plate is hinged at the bottom to a piece of wood, which acts as a platform for the lower edge of the

chase to rest on. It is seven-eighths of an inch thick and two and one-half inches wide. Strips are glued and screwed at either edge of the upright board to hold the sides of the chase, and at the top the chase is held with a brass spring-clip that can be made and screwed to the wood. Four inches from the pressure-plate base three blocks are arranged to support the lever, which is connected to the back of the pressure-plate with a tongue of iron one-fourth of an inch thick, three inches long, and one inch wide (Fig. 10). Quarter-inch holes are bored at each end just two inches apart from centre to centre. Two blocks of wood are screwed to the back of the pressure-plate one fourth of an inch apart, and a quarter-inch hole made in each, to receive a bolt, which also passes through one hole in the iron tongue.

The wooden lever is fourteen inches long, one and one-half inches square at one end, and at the other it is rounded, so as to make it easier on the hands. The square end is rounded off and cut in with a saw, as shown in Fig. 11, and one inch in from the end a quarter-inch hole is made.

The blocks that hold the lever are set one and one-half inches apart, and a bolt passes through the upper end of them and through the lever near the end of the iron tongue. The hole in the lever through which the bolt passes is two



inches from the end hole, and when spaced properly the inside of the pressure-plate should be seven-eighths of an inch from the face of the chase-board when the handle and tongue are in a straight line, as shown in the side elevation of the press (Fig. 12).

Metal type, electrotypes, engravings, and printers' plates are always made seven-eighths of an inch high. When making a press always bear this in mind, and if necessary the pressure-plate can always be built up with hard paper to meet the face of the type if sufficient pressure is not had at first.

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Type, spaces, quads, rule, blocks, ink, and a small roller can be purchased from any printer if there is not a printers'

stock house in the town where you live. If the printer is accommodating, he will answer all your questions about your printing-press, and help you with any details about which you are uncertain.

Stamping

Stamping, or the process of imprinting without the aid of a hand or power-press, is as old as the hills. Away back in the early ages the art of stamping was carried on by means of wooden or stone blocks, on the face of which characters, letters, and various other signs were engraved. Patterns or figures in colors were imprinted on fabrics, parchment, and leathers; and in some of the walls of the ruined houses in Pompeii and Herculaneum there are found well-preserved examples of the stamper's art, where figures of a running pattern are repeated at regular intervals. Both oil and water-color pigments may be used for stamping; but if the imprint is to be made on paper or leather, then printers' ink, diluted with a small portion of benzine, should be used.

Every boy may have an imprint of his initials cut on wood, and use it in stamping his papers, school-books, and other property. In the Far East every prominent merchant has his private signet, and always, when signing his name to documents, he certifies it with his stamp, which is placed beside or across the name, as shown in Fig. 13.

In China and Japan these stamps are called "chops," and are used with a red, brown, or blue ink-paste, which dries hard and indelible on paper, leather, or soft wood.

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The author's imprint so interested a wealthy Japanese merchant a few years ago, that when he returned to Yokohama he had a handsome ivory, bone, and silver "chop" cut by a good maker in that city, and sent it over the sea as a souvenir of his visit to this country. Fig. 14 gives the imprint, and Fig. 15 is a drawing showing the shape of the "chop." The body part is of ivory and the inlay of silver, while the cap, which fits over the engraved die, is of black bone.

Any boy can make a signet of boxwood or maple for stamping paper and wood. For use on leather he can cut his dies in soft copper, which, when heated, will burn the imprint in the leather.

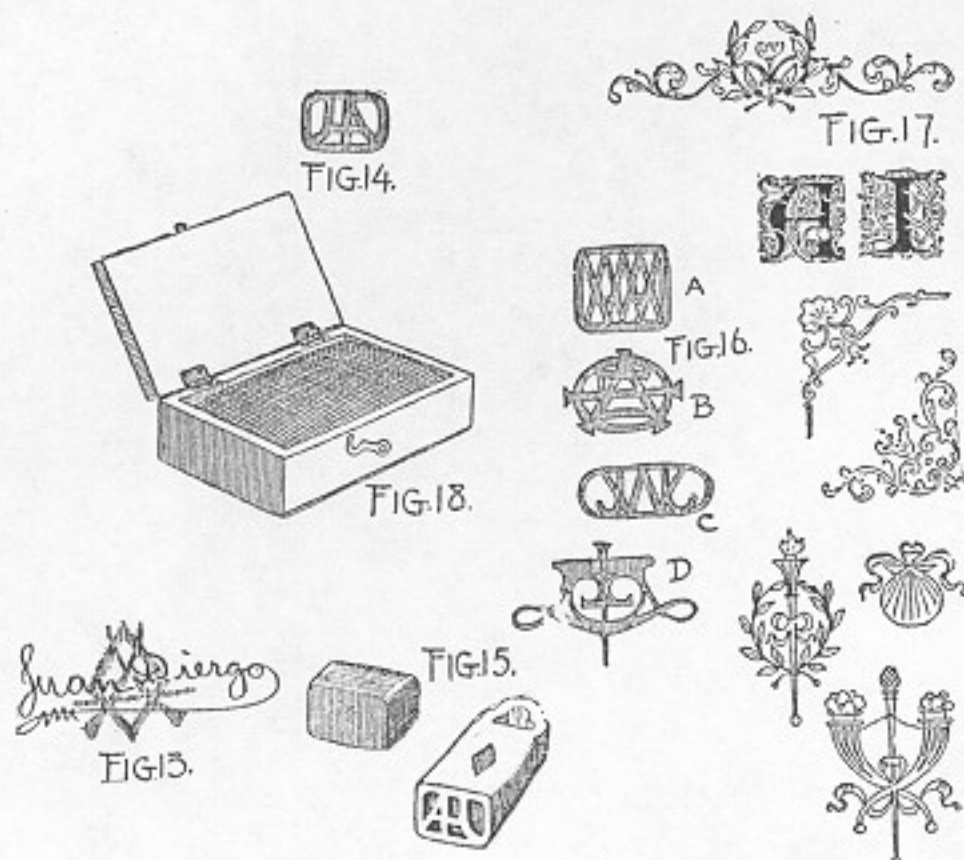
In Fig. 16 four ideas for imprints are shown. In B and C the initials are combined, while A and D are arrangements of scrolls and lines which will be understood as belonging to a certain person, just as trade-marks are the known marks of certain manufacturers.

In order to cut a wood-stamp, it will be necessary to have some fine carving-chisels, a vise, and sand-paper. Maple, boxwood, or other close-grained wood can be used, and it is best to cut the die on the end rather than on the side of the wood. Cut your block the size required; then draw the reverse of the design, as shown at Fig. 15. Cut this as deep as you need it, so that ink or marking-paste will not clog the low parts; then, when the face is properly finished, the die will stamp an impression as shown at Fig. 14. For large dies it will be necessary to use the wood on the side, as

otherwise the blocks would be heavy and hard to handle. Souvenir books or engrossed memorials may be embellished

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with corner ornaments, as well as with capital letters and borders in red, blue, or gold. Any boy who is interested in this branch of craftsmanship can get ideas and designs from gift books, calendars, show-cards, circulars, and the host of illuminated and embellished printed matter that is in circulation. When making these selections, however,



avoid the commonplace printing-house patterns, and favor those to be found in the best magazines, art books, and hand-books of ornament such as are shown in Fig. 17, the

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several parts of which are a miscellaneous lot of ornaments and letters that can be easily copied by the young die-cutter.

Diluted printers' ink is excellent for stamping, and when used it should be spread on a cloth stretched over several thicknesses of flannel and cotton cloth and made in the form of a pad, as shown at Fig. 18. This is a block of wood over which the thicknesses of fabric are laid, the top layer being drawn over the edge and tacked underneath. This block is then placed in a flat box of wood with a hinged cover, so that the pad may be kept enclosed when not in use, and so prevent the ink from drying out. After using the pad a cloth wet with benzine should be laid over the pad; then the lid should be closed and hooked down.

Embossing

In embossing the ornament is raised in low relief, and so lends a rich effect to paper, card, leather, or other ductile material. Embossing is generally done under heavy pressure, and with moisture or heat to facilitate the work. Papers, thin leathers, and some fabrics can be treated in this manner by the boy craftsman after he has mas-

tered the art of making dies. The mode of making bas-reliefs was fully explained in Chapter XI, and for embossing a very low relief is necessary, since otherwise the paper would split or break away on the raised parts. After a well-modelled ornament is obtained, it will be necessary to make a hard casting from it in plaster, and then a casting from this, so that for the work you will have a sharp,

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clear bas-relief and an intaglio—one the expressed design and the other impressed. Make these of hard plaster, and give their surfaces a coat or two of shellac.

To press a piece of paper or leather, dampen it on both sides with a sponge or wet cloth, and heat the dies in an oven. Place the paper over the bas-relief, cover with the intaglio, and apply pressure. Or place some weight on top of the dies and leave them there for half an hour. On removing the paper you will find a perfect bas-relief which, when thoroughly dry, will hold its shape. Book, card, and mounted leather-work is treated in a hot press, but only for a second or two—just enough to drive the dies together, heat the material, and cause it to hold its shape.

Chapter XVI

A HOUSE GYMNASIUM

ALL healthy-minded boys are interested in physical development; it is the instinct which leads them to climb high trees and scale precipitous cliffs, generally at the expense of some anxiety to the minds of their parents and guardians. But these amusements are more in the nature of "stunts," pure and simple; the logical and rational field of athletic culture is the gymnasium. In the large cities, and at schools and colleges and Y. M. C. A. societies, there are opportunities in abundance for gymnastic exercises. The purpose of this chapter is to show the boy who has to stay at home, or who lives in a small country village, what can be done in the way of rigging up a barn floor or a spare room like the one shown in Fig. 1. He can also make most of the apparatus; for, with a few exceptions, all the principal pieces are simple in construction and not beyond the ability of the average boy.

For indoor exercise the outfit must necessarily consist of those pieces of the gymnasium equipment that can be used when in a standing or sitting attitude, for the confined space of the average room will not admit of running, jumping, or leaping with the pole or from a spring-board. In preparing a

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list of the pieces of equipment suitable for a boy's "gym," some of the familiar ones have been omitted, as they are either beyond the ability of the average boy to make or they are too cumbersome for the home. The apparatus that is described and illustrated is simple and practicable and can be made at a much lower cost than the prices charged at the shops.

Dumb-bells

Wooden dumb-bells weighing a pound each may be pur-

chased for about fifty cents a pair, but the boy who is in-

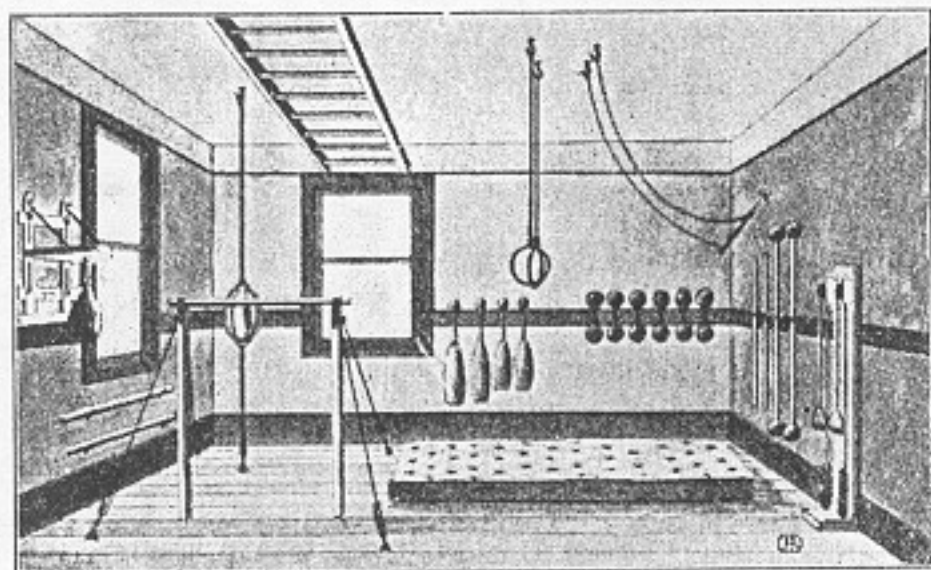
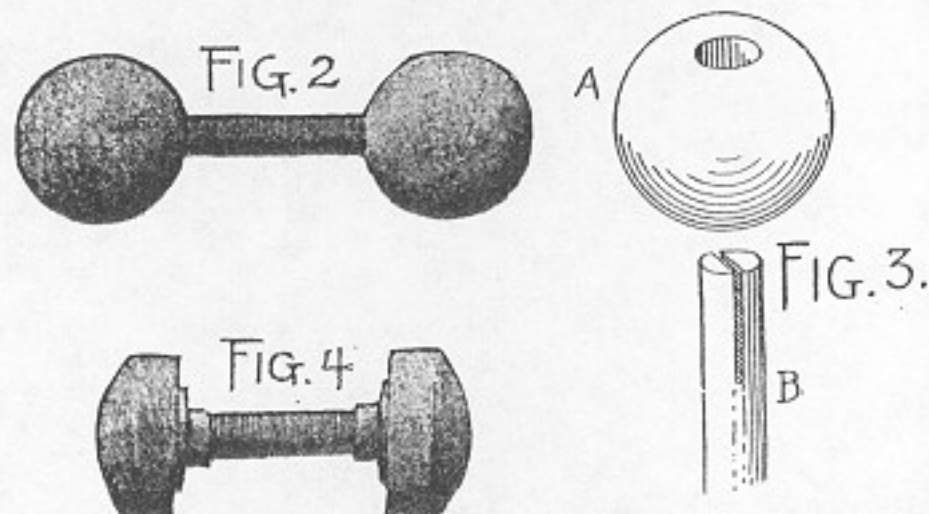


Fig. 1

terested in making his entire equipment can use croquet-balls with broom-handles, or one-inch curtain-pole sticks, for handles (Fig. 2).

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To make these dumb-bells, obtain some old croquet-balls and clamp them, one by one, in the vise of a carpenter's bench. Then, with a one-inch bit, bore a hole through each ball, as shown in Fig. 3. Cut a broom-handle or a one-inch curtain-pole in lengths twelve or thirteen inches long, and in the end of each make a saw-cut, as shown in Fig. 3 B. Smear the end of the stick with glue and drive it through the hole in the ball, keying it firmly in place by driving a wedge into the end of the stick, just as hammer-heads are fastened to prevent their coming off. Repeat for the second ball. Some glue should be placed in the saw-cut, so as to hold the wedge when it is driven home. To make the handle easier to grip, it should be bound with linen or cotton fish-line; then the balls may be painted or varnished, and the line given a coat of black varnish, which will set the cord binding and harden it. Several sets of these balls may be made for the "gym" and hung upon the wooden rail that extends around the room.

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In the absence of iron bells, a heavy pair of dumb-bells may be made of gas-pipe handles and flanges with screw-holes fastened into wood blocks four inches in diameter (Fig. 4). The gas-pipes, an inch in diameter, may be had

at a plumber's shop or gas-fitters', and they should be five inches long, threaded at both ends, and screwed into flanges which have been fitted with threads to receive them. These flanges are bored with holes, so that ordinary screws may be passed through them and into the wooden ends. The gas-pipe should be bound with line and painted or varnished, or the entire bell may be painted black to simulate iron.

Indian Clubs

A good pair of Indian clubs, weighing from two to three pounds each, would cost at the shops about one dollar a pair; but the boy who can handle tools may cut out a very serviceable pair of clubs from wood four inches square or round, with the club, or butt, ends fifteen inches high.

Two pieces of spruce, chestnut, or apple wood are to be cut, as shown in Fig. 5. The upper end should be tapered so that it is one and a half inches in diameter, and leaving the base about two and a half inches in diameter.

The tapering is done by holding the wood in a vise and gradually shaving away the wood with a sharp-bladed draw-knife or spokeshave, turning the wood frequently so as to cut the butt evenly and as true as possible. With a brace-and-bit a one-inch hole is bored in the top of each club three inches deep, and into it a broomstick-handle is driven and held in place with glue and a few steel-wire nails. Wooden

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balls are bored and glued to the top of the handles, and given an additional purchase with small nails. The handles may be bound with fine line and the exposed wood-work painted any desirable color.

Half a dozen sets of these clubs will add materially to the equipment of the household "gym"; and it would be advisable to make them in several sizes—say from one to three pounds each.

Calisthenic Wands and Ball-bars

These wands, three to five feet long, may be cut from any hard-wood, or the same lengths of a one-inch curtain-pole will answer quite as well. Plain square sticks may be planed octagonal in shape, or rounded, as a matter of choice (Fig. 6 A).

The ball-bar (Fig. 6 B) may be made as described for the dumb-bells, by boring croquet-balls and attaching them to the ends of a bar with wedges.

In many schools calisthenic exercises with wands, dumb-bells, and ball-bars are regularly taught; and the boy who has provided his own gymnasium with the simple apparatus required will find pleasure in rehearsing the school instructions at his home.

Swinging-rings

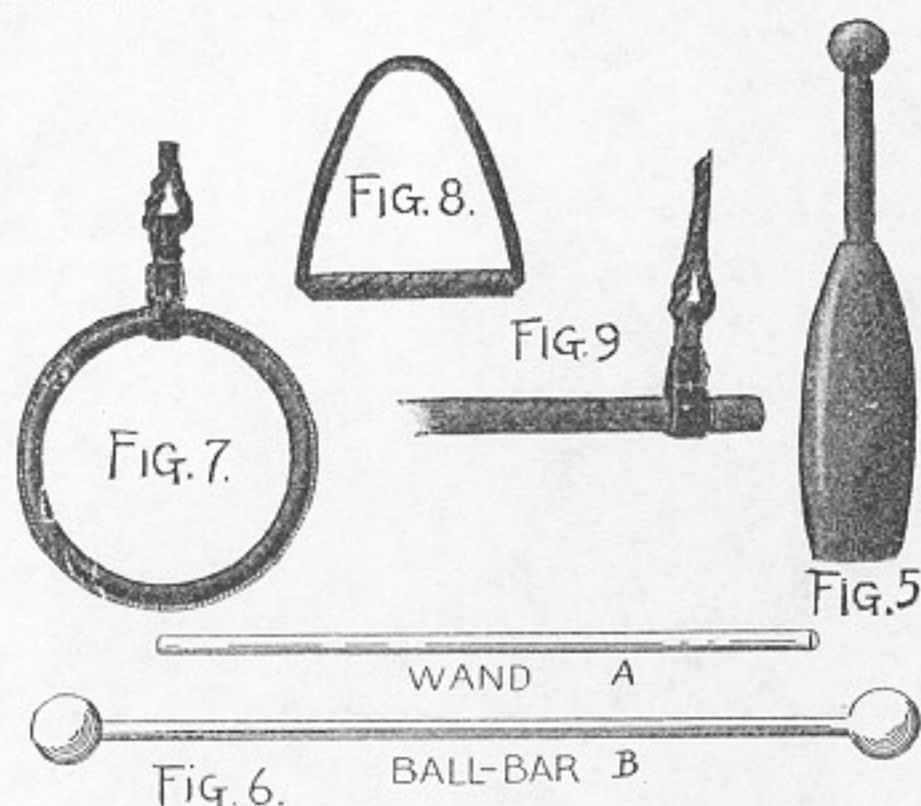
Exercising and swinging rings are usually from six to ten inches in diameter, outside measure, and they may be purchased at the shops for one or two dollars a pair, according to the size and finish.

A blacksmith will make you a pair of rings, eight inches

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in diameter, out of five-eighth-inch round iron, for about fifty cents; and with a fine file and emery cloth they may be smoothed down so that they will not chafe the hands. Some rings are nickel-plated, but they are used only by professionals in their exhibition work.

The rings should give a good grip, and there is nothing better for this than to bind them with tire-tape, or sew



leather around them, making the seam at the outside, as shown in Fig. 7. The sewing should be done with doubled and waxed linen thread; if this should prove too difficult, a shoe or harness maker will help you out for a small sum.

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In Fig. 8 a triangle is shown having the lower side bound with tape or leather. This triangle is six inches across the bottom, eight inches high, and is made from half-inch round iron. As the lower side is a straight bar; it is somewhat easier to grip than the segment of a circle.

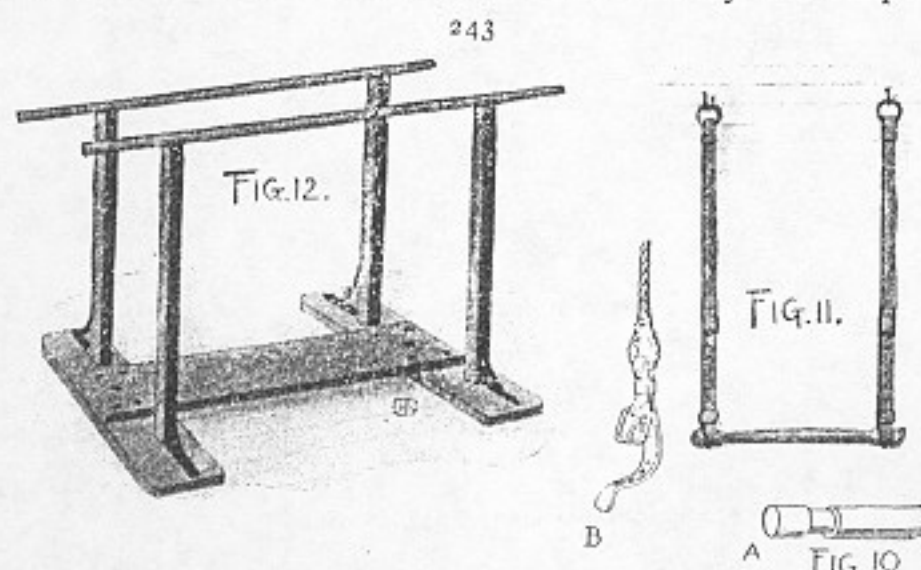
The rings, or triangles, should be suspended by means of ropes, at the lower ends of which straps are provided so that they will hold rings, rods, or trapeze bars. A harness-maker will make these straps for fifteen or twenty cents each, of substantially heavy leather. They should be provided with a stout buckle and a loop under which to slip the strap end, as shown in Fig. 9. The rope ends, through which the straps are caught, may be spliced or formed into a loop-end and bound tightly with twine to make a strong union, as also shown in Fig. 9.

Trapeze Bars

For the house gymnasium a trapeze bar should measure four feet long and one and three-quarter inches in diameter; it should be cut with a path at each end, as shown in Fig. 10, so that the strap may be wrapped around it and drawn tight. The bar should be made of seasoned hickory. The wood may be bought from a wheelwright or wagon-maker, and then dressed down with a plane and spokeshave. The arrangement for the suspension is shown in

Fig. 10 B.

The adjustable flying trapeze, as shown in Fig. 11, is made from trunk-straps, provided with two extra loops, and a four-foot bar cut from two-inch hickory and shaped



with a spokeshave. At the ends, paths are cut to receive the straps, and, if possible, have the bar turned in a lathe to insure a more accurate job. Small rings at the upper ends of the ropes or straps, and hooks driven securely into the ceiling-beams, will afford the needed suspension.

Parallel Bars

The regulation parallel bars are usually supported on iron pipe-standards bolted to a heavy base, and steel heads are provided to grip the bars. But this fitting is beyond the ability of a boy to construct without the aid of a plumber, and the wooden frame base and bars shown in Fig. 12 will answer quite as well.

The bars are of hickory, five and a half feet long and two inches in diameter. The uprights that support them are of oak, ash, or other hard-wood, two and a half inches

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square and forty-two inches long. The lower ends of the uprights are set into bases of heavy hard-wood two inches thick, ten inches wide, and three and a half feet long. Square holes are cut in the middle of these bases, two feet apart, so that eight inches of wood will extend beyond the holes at each end, and so provide a surface on which to screw the bracket-ends that act as braces to the uprights. The holes should be cut with a brace-and-bit all the way through the bases, and then trimmed with a mortise-chisel and mallet, taking care to make them very accurate, and so prevent any play to the uprights when once set up.

The stepping-plank is also of hard-wood, twelve inches wide, one and a half inches in thickness, and long enough to span the cross-planks. The distance between uprights should be about four feet. The stepping-plank should have a two-inch block under the middle to prevent it from springing; it is to be attached securely to the cross-plates with large, flat screws driven into holes that have first been bored out with a bit. Hollows are cut out in the top of each upright with a compass-saw, and the sides slightly tapered to the edges of the U cuts, so as not to interfere with the

hands when using the bars. Fasten the bars to the uprights with two slim screws at each side, driven through the uprights and into the under sides of the bars. Do not put a screw or nail down through the bars and into the top of the uprights, for this will weaken the bars, and if the weight is suddenly transferred to the extreme ends they might snap off.

At a hardware store purchase four iron brackets with eight-inch tops and ten or twelve inch sides. Invert them

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and screw the tops to the base-boards and the sides to the outer edges of the uprights, to insure added rigidity.

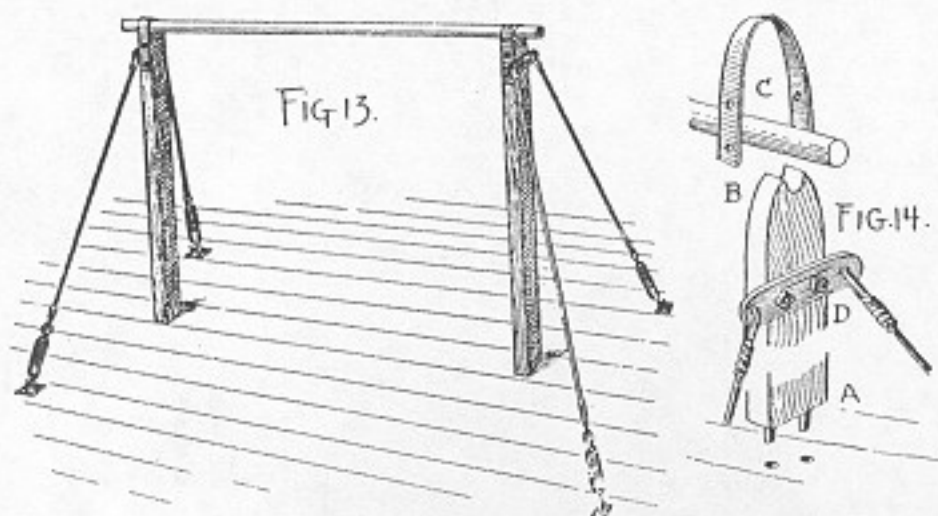
A coat or two of paint will improve the appearance of the uprights and base; but do not coat the bars with anything. They should be polished with an oiled rag until smooth enough for use.

A Floor Horizontal Bar

The complete apparatus is shown in Fig. 13. The hickory bar, one and three-quarter inches in diameter and four feet long, is supported on hard-wood uprights two inches thick, three inches wide, and as high as the bar is desired—say from five to six feet, according to the stature of the boys who are to use it. At the lower end the uprights are held in position by two half-inch iron pins driven into the bottom. These fit into holes made in the floor in a corresponding position, as shown at A in Fig. 14. The upper ends of the uprights are cut with a compass-saw to receive the bar, and the edges are tapered to meet the edges of the U cut, as shown at B in Fig. 14. When the bar is in place it is held with straps made of one-eighth by one inch iron. They should be provided with screw-holes, as shown at C in Fig. 14. The ear-plate attached to each upright under the bar (and to which the stanchion wires are fastened) is made of one-inch tire-iron a quarter of an inch thick; it is bolted to the wood as shown at D in Fig. 14. A blacksmith will make the strap and ear-plates for a small sum; and at a hardware store staple or eye plates may be purchased and screwed to the floor, into which the turn-buckles can be caught.

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Four turn-buckles and some stout wire form the stanchions; and the floor-plates should be located so that they not only brace the structure forward and backward, but also from side to side, as may be seen at the right side of Fig.



13. If the plates are five feet apart, they should be eighteen inches out from each upright.

The particular advantage of this bar over a swinging one lies in its absolute rigidity. Also, when not in use, it may be cleared away by loosening the turn-buckles and unhooking them, lifting the pins out of the floor and carrying off the frame bodily.

Striking-bags

There are various kinds and shapes of striking-bags to be had at the shops, but a converted Rugby football will answer very well for home use. Remove the bladder and sew two large bone buttons to the leather cover at each

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end, as shown in Fig. 15. The bladder should then be replaced, inflated, and the cover laced up tightly.

Leather straps, in the ends of which button-holes have been made, are caught over the buttons to form loops to which the ends of the suspension and draw ropes are attached. These straps are reinforced with a patch of leather sewed at the middle, as shown in Fig. 16. The patches will strengthen the straps and prevent them from stretching too much when the ropes are drawn taut.

Between the ball and the floor a spring, or some stout rubber bands, should be placed so as to make the ball rebound quickly when struck.

The portable striking-bag (Fig. 17) is attached to the top of a staff, and is made of leather or canvas and stuffed with paper wads. Or a bladder, inflated the same as a football, may be used. The bag or cover for a bladder should be made of strips of leather or canvas sewed together. The inflated bag is then covered by a stout leather cap. Straps of canvas or leather are sewed to this cap and brought down below the bag, where they are attached to the staff with a thong or cord, as shown in Fig. 17.

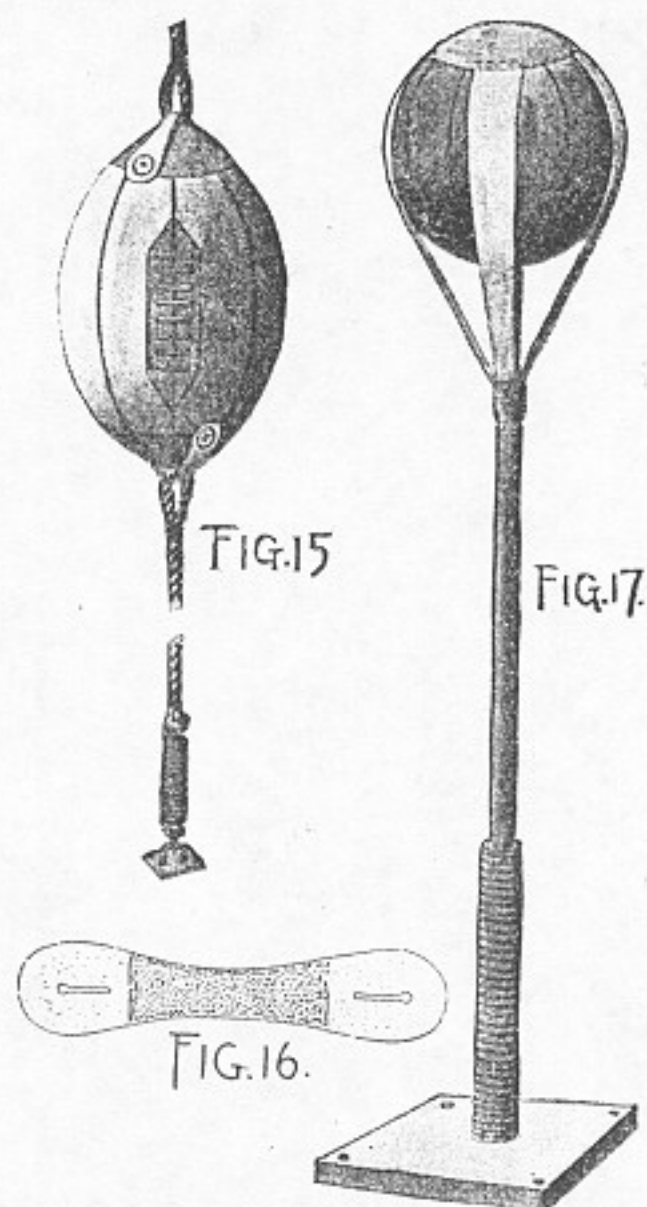
The regulation portable bags are mounted on an iron base, but in our home-made apparatus a plate of hard-wood will have to answer. From oak, ash, or other hard-wood, two inches thick, cut a base fifteen inches square, and round off the edges on the upper side. Make a hole in each corner through which to pass a screw, and a large hole at the middle to receive a spiral spring. The staff (about the size of a broomstick) is screwed down into the top of the spring for five or six inches, or enough to hold it securely; and at the

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bottom the spring is held in the block with screws or nails driven through the wires of the spring and into the wooden base.

When using the bag it should be fastened to the floor with two or three screws, so that it will not topple over. As it is struck it bends over from the bottom, and the spring, if stiff enough, will cause it to immediately rebound or come to an erect position.

A striking-bag and disk, like the one shown in Fig. 18, may be made from wood and leather, a few thumb-nuts, and a pair of braces. To make the adjustable disk, obtain two pieces of white-wood or pine three inches wide, two



STRIKING-BAGS

feet long, and one and a quarter inches in thickness. Also two other pieces, each an inch thick, three inches wide, and thirty inches long. The first pieces are the wall-plates, and laps are to be cut one and a half inches in from each end, as shown in Fig. 19, to receive the upright pieces.

In the middle of each lap a bolt two and a half inches long is to be set. This projects through a slot cut in the upright pieces, and at the outer end of the bolt a thumb-nut and washer will make it possible to clamp the uprights fast to the wall-plates, so that the disk may be raised or lowered to any required position.

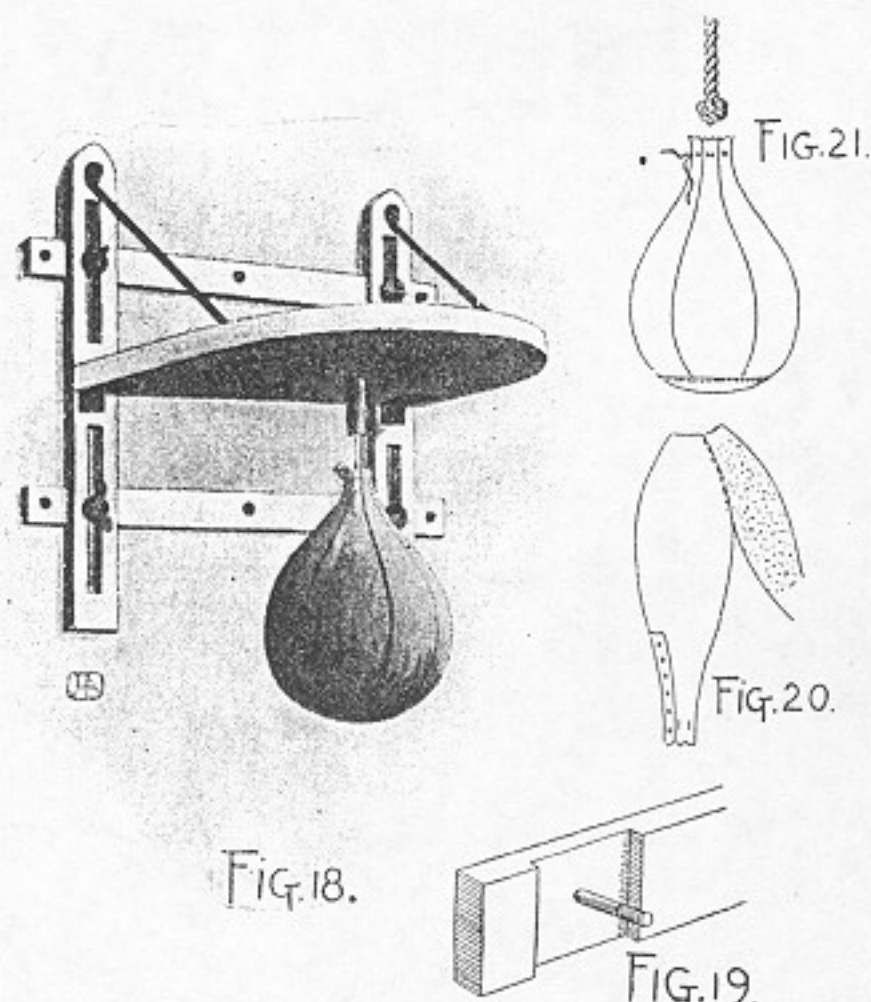
Two slots, as wide as the thickness of the bolts, are cut in each upright with a bit and compass-saw; and on the uncut space, at the middle of the frame, a disk twenty-one inches wide and twenty-six inches long is made fast with screws and short angle-brackets attached to the under side of the rear corners. This disk should be made of hard-wood one and a half inches in thickness, and it is braced from

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above with two irons that extend from the top of the disk to the upper ends of the uprights. A blacksmith will make these for a few cents each, and they, as well as the other hardware, should be painted black to give them a good appearance.

The bag is shaped like an inverted balloon, and is made

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of six pieces of leather, or canvas, five and a half inches wide and fifteen inches long, sewed together at the edges. Each piece should be shaped as in Fig. 17, and when they are sewed together a round cap should be made fast to the large extremity to secure the ends of the side-pieces. A patch is sewed along the edges of two sides to strengthen them and to pass the lacings through, as shown at the lower left-hand side of Fig. 20. This method of construction gives an opening through which to pass a filling of rubber scraps and bits of leather. If a rubber bladder is to be inserted and inflated, this opening will not be required, for the bladder, when collapsed, may be pushed into the opening at the neck.

One inch below the top of the neck some slits are to be made in the leather, through which the throat-laces are interwoven, as shown in Fig. 21. After the knot at the end of the suspension-rope has been inserted in the throat of the bag, the laces are drawn tight and tied. This is the best means of attaching the bag to the rope from which it is suspended; and by means of a hollow stick, which projects down five inches below the under side of the disk, the bag may be centred and held rigidly. As a result it flies up at varying angles from this centre-drop when struck from different sides.

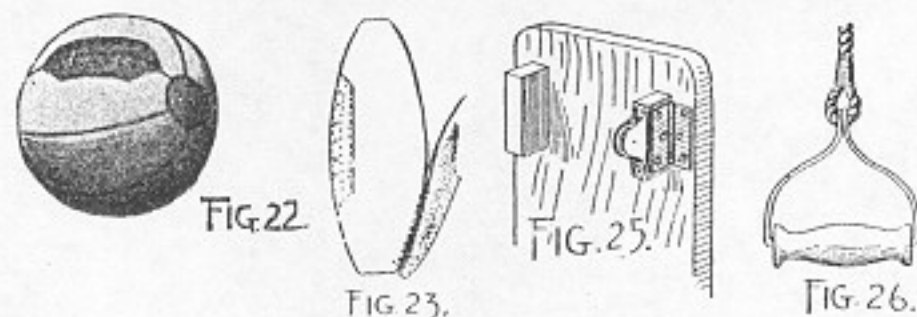
The suspension-stick may be made from a piece of inch-and-a-half curtain-pole, the hole being bored out with a bit. The stick should be inserted through a hole made in the disk eleven inches in from the outer or projecting edge. It should be of such a size that it will be necessary to drive the stick in with a mallet to make it fit snugly. A coat or two of white

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paint will finish the wood-work nicely, or it may be given a coat of varnish.

A Medicine-ball

A medicine-ball should be ten inches in diameter, and should weigh from three or four to six or eight pounds, according to the size of the boys and girls who use it. The case of a round football may be used, or a leather case may be made of six pieces and two ends, so that it will lace up, as shown in Fig. 22. The case is stuffed with small balls



made of pebbles or small stones wrapped in newspaper. The newspaper makes a soft cushion, and does not allow the hard edges of the stones to come in contact with the leather. Larger or smaller stones may be used according to the weight desired, or sand wrapped in paper may be used in place of the stones.

If the case is to be made, obtain some russet leather from a shoe-maker and cut six pieces, fourteen inches long and six inches wide, as shown in Fig. 23. With doubled linen thread sew the edges together so that the seam is at the inside, as shown at the lower end of Fig. 23. Reinforce two

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sides of adjoining strips with a patch of leather sewed securely all around the edges and through the middle. Punch holes along the patch half an inch from the edge, through which to lace the draw-strings, as shown at the left-hand side of Fig. 23. At the open ends of the leather case sew on circular patches, four inches in diameter, to securely hold the ends of the six leather sides. The case will then be ready for the filling.

By substituting a bladder for the filling, this medicine-ball may be used as a volley-ball. The volley-ball is played over a net, either in the "gym" or out-of-doors, in a fashion similar to Badminton. It may be played by any number of persons at the same time, the object being to keep the ball in motion over the high net.

Pulley-weights and Exercisers.

No apparatus for home exercise covers the field so generally and thoroughly as the chest-weights, or pulley-weights. No instructions are necessary, for the boy who uses the apparatus can follow his own idea for strokes, and every muscle in the body may be easily and pleasantly exercised, there being sufficient variation in the movements to relieve them of monotony.

An exerciser similar to the one in Fig. 24 may be constructed out of a piece of plank, two pulleys, a pair of sash-weights, and some cotton rope or clothes-line.

Obtain a piece of pine or spruce plank twelve or fourteen

inches wide, five feet long, and one and a quarter inches thick; also another piece to form the foot, so that it will project

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FIG. 24.—AN EXERCISING WEIGHT

six inches from the base of the plank. Two blocks of wood, four inches long, two inches wide, and an inch thick, will be necessary for the pulleys to swing on. Attach these to the upper end of the plank by means of hinges, as shown in Fig. 25. They should stand out from the board, and in from the edges, the distance of the width of the hinge-leaf, as also shown in Fig. 25. Plate-pulleys are screwed fast to the front edges of these blocks, through which the ropes pass that raise the weights.

The foot-board should be padded with hair or excelsior and covered with leather or burlap, so that the weights may drop on it without making any noise.

From two old tin pails remove the handles and bend the wires around so that a rope may be passed through the eyes at the ends, as shown in Fig. 26. At a hardware store purchase a pair of five-pound sash-weights, and pass the rope ends through the eyes. They should then be spliced or bound with fine line. When the ropes are reeved through the pulleys, a knot should be made in each one, so that it will chock in the top of the pulley and allow the weights to just reach and lightly rest upon the foot-pad. Therefore, when the handles are released the weights will

not fall about on the floor as they would otherwise do. The ropes should be about five feet long from the eyes of the weights to the handles. That is quite sufficient to give a good long stroke while bending the body forward or from side to side.

This exerciser may be screwed fast to the rail that should extend all around the "gym," and also into the floor at the foot to steady it. Lighter or heavier weights may be em-

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ployed, as the strength of the boy will warrant, but light weights are preferable to heavy ones for continued use.

An Attic Gymnasium

In Fig. 27 a good idea is given for the arrangement of an attic gymnasium; it shows the locations of the paraphernalia in a room about fourteen by sixteen feet. A smaller

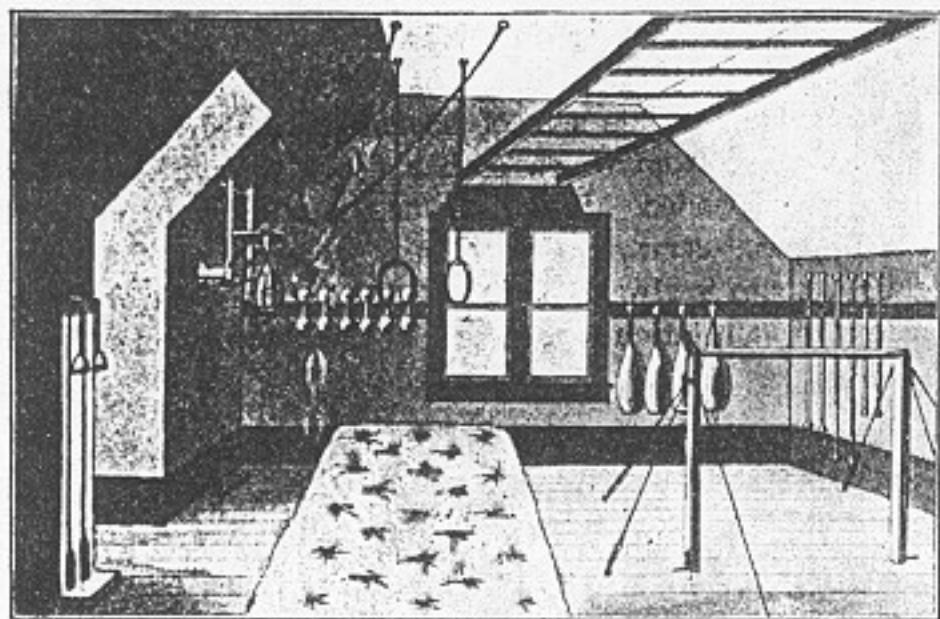


Fig. 27

room may be arranged in a somewhat similar manner, but each piece of apparatus must be cleared away directly it is out of use.

Across the top of the room, from a window-casing to a batten screwed fast to the opposite wall, a ladder may be

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suspended. Over the window-casing it would be well to attach a batten, so that the ladder will not spring out of place. A rope hanging from one end will make it possible to reach the rings.

A strip or band of wood four or five inches wide should be nailed all around the room four feet above the floor, against which to place parts of the gymnasium equipment, and on which to hang dumb-bells, Indian clubs, wands, and ball-bars, as shown in the illustration.

Under the trapeze or rings it is well to place an old mattress, a useful thing in the event of a fall. If the room is wide enough, double sets of hooks may be driven in the ceiling-beams from which both a flying trapeze and rings may be suspended. When one or the other is in use, the extra apparatus may be drawn up or to one side of the room. A light room is always more cheerful than a dark one, and plenty of ventilation is necessary in the home gymnasium.

Chapter XVII

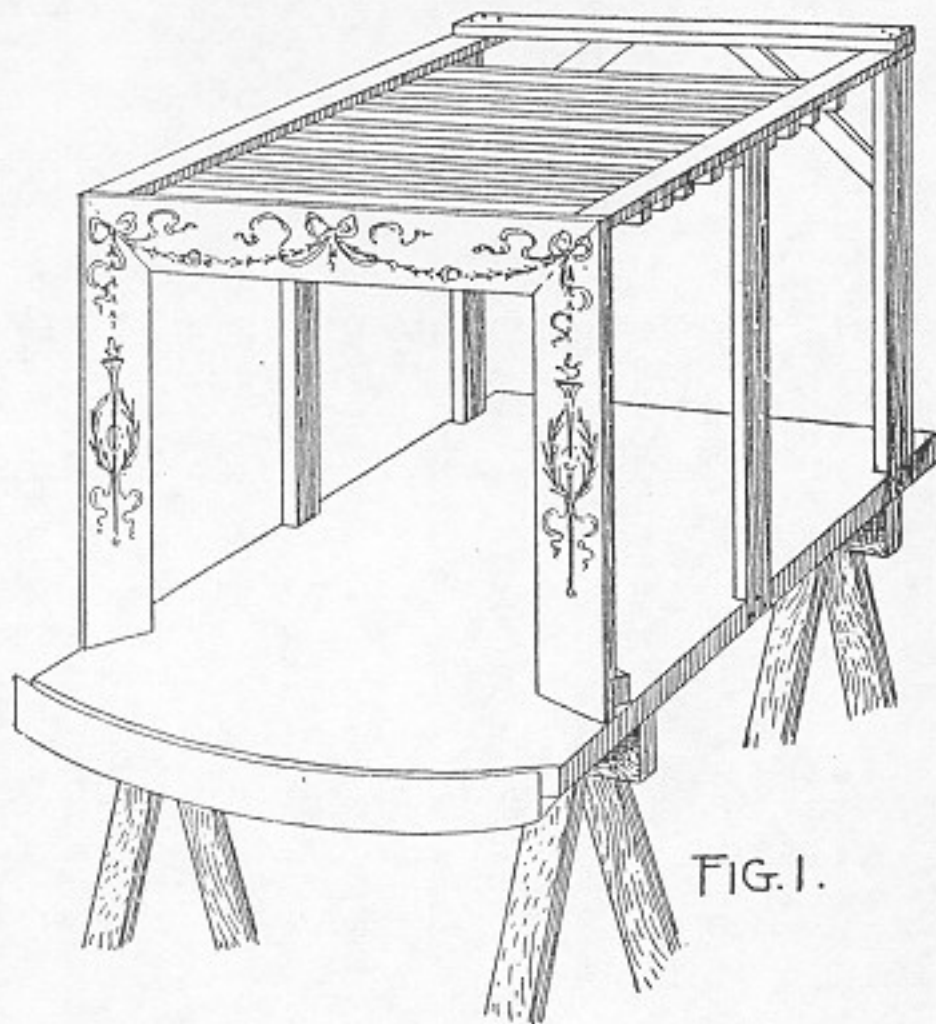
A MINIATURE THEATRE

A MINIATURE theatre, equipped with curtain, flies, drops, wings, and several good sets of scenery, is an unfailing source of interest and amusement. It has long been popular in Paris even as a professional form of entertainment. Fig. 1 gives the front elevation of a miniature theatre; and Fig. 2, a side view, illustrates the location of the working parts, and the manner of arranging the wings, drops, and flies.

This theatre must be made of such a size that when it is placed at one end of a room the audience will have a good view of the fore, middle, and back ground. A good size for the stage is four feet wide and five feet long over all, the front being slightly curved, as shown at B in Fig. 3. The proscenium should be four feet wide, three feet high, and with a sight-opening three feet wide and thirty inches high.

The proscenium is made from three boards seven inches wide and seven-eighths of an inch thick. The upper corners are bevelled and mitred, so that the inner edges will be recessed, as shown in the plan drawing Fig. 3 A A. The top-rails are caught at the front to the top of the proscenium with screws, and are supported at the rear and middle by

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uprights, the lower ends of which are let into the sides or edge of the stage, and then made fast with glue and screws, as shown at C C C C in Fig. 3. Cross-braces at the back and middle of the top are screwed to the top-rails for strength. Bracket or brace pieces are caught at the rear of the last rail and to the rear of the last uprights midway between

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stage and top, and are made fast with glue and screws, as shown in Fig. 4. These will hold the framework securely in position.

Gas, electric light, or candles may be used for the foot-lights. If gas is employed a small pipe should run along under the front of the stage. Over this pipe a tin cornice is arranged with holes made through it every three inches. These holes should be just large enough to admit gas-jets which project through it, as shown in Fig. 5. The supply of gas can be controlled at one side by means of a key, so that the lights may be lowered or turned up full. If candles are used they should be arranged on a board, so that as they burn lower and lower the board can be raised. If electric lights are available, they are the best of all, since the danger of fire is reduced to a minimum. The small sockets, wire, and lamps used for Christmas-trees can be employed, and will give very good results.

Scenery and Equipment

After the constructional work of the stage and frame is complete, it will be necessary to make the scenery and equipment. It will be best to have two curtains, the first a fancy one which can be painted on muslin or a window-shade. Window-shades come printed with pictures on them, and these can be strengthened with oil paints diluted or thinned with benzine. A very pretty outer curtain can be made from a printed Japanese silk panel, such as are for sale in the art and dry goods-stores. This can be sewed on a plain piece of goods, and the upper end made fast to a

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shade-roller, as shown in Fig. 9. The main curtain may be of denim, stout muslin, or any suitable cloth or fabric. It is nailed to a round stick (a curtain-pole is preferable), which is cut at the ends as shown in Fig. 6. The draw-string is wound in this groove, and so the curtain is raised and lowered. The shade-roller curtain is the outer one, and is attached to the frame at the top, and just back of the proscenium, as shown at B in Fig. 2. The main curtain is just inside the outer one, and is made fast to a stick near the outer curtain-roller. When down, the roller rests on the stage just back of the proscenium, as shown at C in Fig. 2. When the curtain is rolled up to the top of the proscenium-opening, a few turns of cord are taken about each end of the roller in the groove. The cords then pass through screw-eyes to the back of the stage-frame, where they can be held on a small cleat. Both cords pass through the same eyes, so that the pair of strings may be operated by one hand. The drop-curtains at the back of the stage are painted on window-shades, the rollers of which are hung on blocks at the under side of the top-rails and close to the rear uprights, as shown at A A A in Fig. 2.

The flies are strips of muslin painted to represent sky in out-door scenes and ceilings in interior sets. The flies are tacked on a stick, the ends of which project beyond the body part of the fly so that they may rest on the top-rails of the stage-frame, as shown in Fig. 7. The fly part drops down

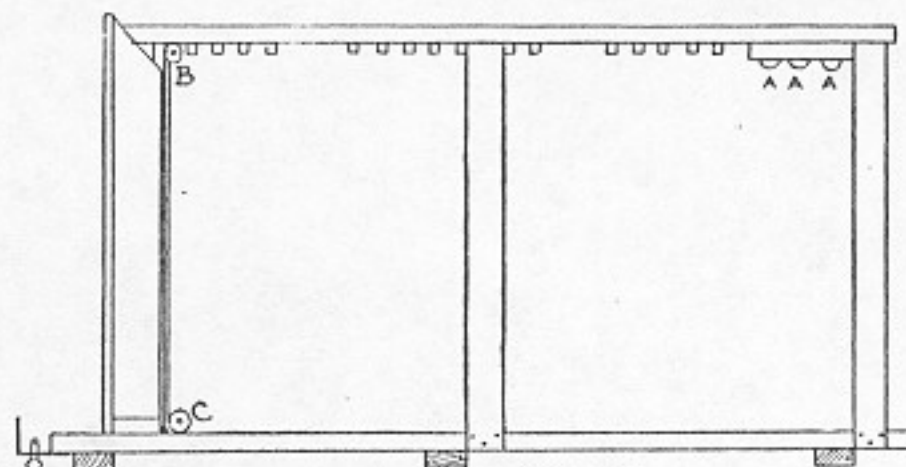


FIG. 2.

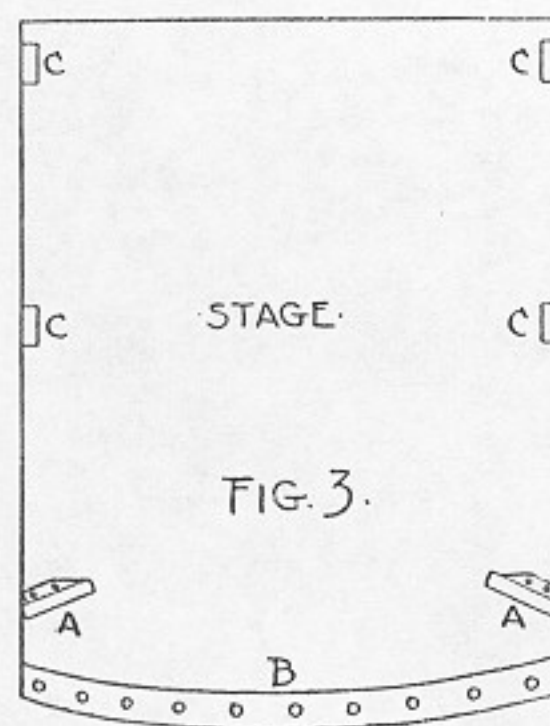


FIG. 3.



FIG. 4.

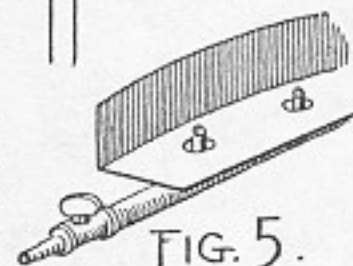


FIG. 5.

DETAILS OF STAGE

two or three inches below the upper framework, so as to be visible to the spectators. The wings are of card-board or stiffened muslin tacked on frames, the bottoms of which rest on the stage. The upper part is held between the runners,

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or cross-rails, fastened to the under side of the top-rails, as shown in Figs. 1 and 2.

The front and back of a wing is shown at Fig. 8. The front, A, is the smooth side on which the tree or other feature can be painted. The back, B, shows how the frame is made to support this piece of scenery. The frame should be constructed of pine sticks three-quarters of an inch wide and half an inch thick. Where they cross each other laps should be cut out of each piece, so that one will lie flat in the lap of the other. The surfaces of all the sticks being on one plane, the frame offers a flat surface for the material to back against.

An independent piece of scenery, such as the house, tree, fence, and bushes shown in Fig. 10, will have to be built upon a frame, and a foot must be provided so that it will stand on the stage independent of any top, bottom, or side braces. The manner of doing this is shown in Fig. 11, the two feet being "loaded" with pieces of lead at the ends of the feet so that the house cannot topple forward. Very pretty scenes can be made from card-board and of stiffened

goods, such as crinoline, over which the painting can be done. Books, magazines, and photographs can be drawn on to offer suggestions for scenery and interiors, and the smart boy, who has some idea of perspective, can design and make some most attractive stage-settings for this miniature theatre.

The Puppets

The actors and actresses should be celluloid or *papier-maché* dolls, their feet being attached to thin strips of wood,

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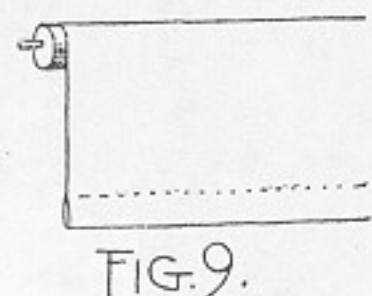
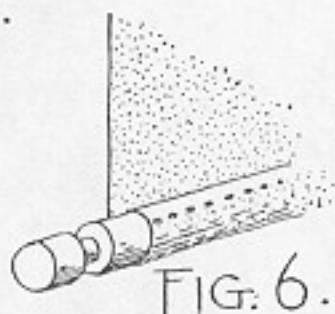
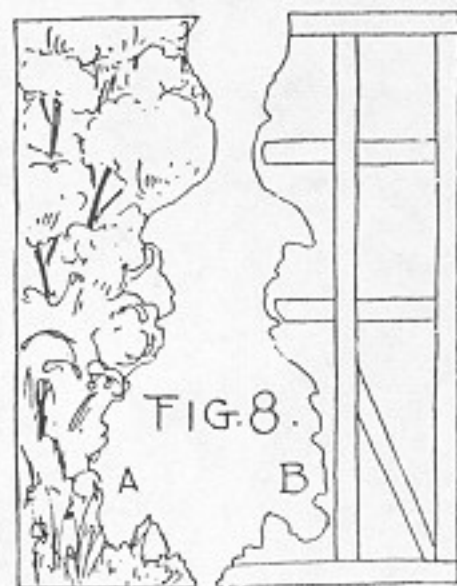
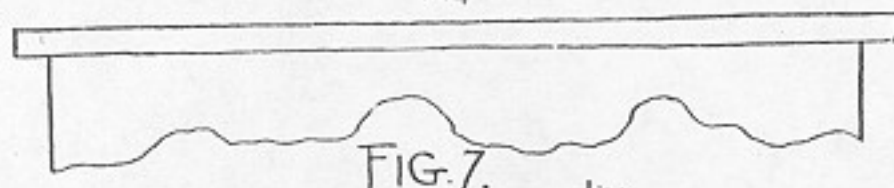


FIG. 10.

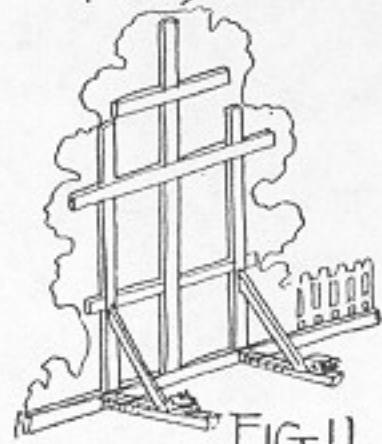


FIG. 11

SCENERY SETS

which can lie flat on the stage and be operated from the sides. When the stage is on a line with the eyes of the audience, these thin strips will hardly be noticed. Jointed dolls may be used for the actors who have occasion to sit during the performance, but it is difficult to bring about the change of posture without destroying the illusion. Trap doors and other pieces of stage machinery may be added as found necessary, and there is no limit to the ingenuity that may be exercised in equipping our miniature stage.

Of course the speaking parts are taken by boy and girl performers, who stand on either side of the stage, and are concealed from the view of the spectators by screens or curtains. The stage-manager and his assistant stand still

closer in, so as to manipulate the puppets. A curtain-bell arranged under the stage, and rung by a knocker or electric apparatus, adds to the realism.

This theatre is to be mounted on two horses, and it must so be screened off that nothing is visible but the proscenium, fore-stage, and footlights. This curtaining may be done with heavy muslin, or Canton flannel of dark color, or any material through which light will not show.

Chapter XVIII

FITTING UP A BOY'S ROOM

WHEN once a boy realizes what may be done in the way of fitting up his den or room, he is sure to take an interest in the subject. A certain amount of manual skill and artistic feeling are, of course, desirable, but these qualities may be cultivated, and to a much greater extent than one would at first be willing to believe.

The color schemes, designs, and general suggestions in artistic handicraft that may be carried out in fitting up a boy's room are almost without limit; but the following ideas are all practical, and the illustrations and explanations should enable the young craftsman to get satisfactory results at the minimum of labor and expense.

In the selection of woods from which to build furniture, the natural product of the locality in which the boy lives must be taken into consideration. Some States grow pine, white-wood (cottonwood), poplar, or cypress, while in others spruce, hemlock, maple, and fir will be found easier to obtain. In the Far West, gumwood, redwood, cedar, and cypress form the staple supply. The cost of the wood is a matter to be considered, and often the more artistic result may be secured by using an inexpensive wood, since the

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beautiful grain of the finer varieties can only be brought out by the skilled and experienced workman. Many woods have an open and broad grain that, if carefully filled and varnished over, will give a very pleasing effect. Chestnut, butternut, quartered oak, and ash have this quality, and all of them are adapted to furniture construction and room trimmings. For chairs and other furniture, spruce, apple-wood, and cypress will give good results; and all of them have a pretty grain when stained and varnished. Ash is harder, and makes good, solid furniture. If not found too difficult to work, it will prove a very satisfactory and serviceable wood for chairs, tables, benches, and other pieces of furniture that are subjected to hard usage.

In the construction of the various pieces of furniture illustrated, the simple rules of carpentry are to be followed, and only the lap, mortise-and-tenon, and tongue-and-groove joints are employed. These joints must be well made, however, so that perfect unions will result, for every piece of furniture will rack in time if not properly braced. For this reason only the plain joints are advocated for the young workman; and nothing has been said about the dowel, key, and other joints that are frequently employed by cabinet-

makers in the general construction of furniture. These latter require much more care and accurate fitting, and for the open and exposed joint the simple forms are far better.

A Plain Chair

Of all the pieces of furniture in the house, chairs are the ones most used, and, as they are subjected to hard usage

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they should be well constructed and the joints carefully made.

In the plain chair shown in Fig. 1 the front legs are sixteen inches high, the back supports are thirty-four inches high, and all of them are one and three-quarter inches square. All the side-rails and the four that support the seat are two inches wide and three-quarters of an inch in thickness, so that the laps cut in the corner-posts (Fig. 2, A and B) will correspond in width and depth. The cross-cuts are made with a fine saw, and the wood removed with a broad firmer-chisel, taking care, however, not to cut deeper than three-quarters of an inch when removing the wood. Use a mallet to help the chisel, but do not seek to take out too much at one time; better try three or four times, and take a moderate bite each time, than run the risk of having a large chunk come out and bring with it some of the wood that should be left for the rail-end to lap against.

The rail at the front is eight inches above the floor, and those at the sides are four inches. At the back the distance is ten inches from the floor to the under side of the cross-rail. Take care to make the saw-cuts inside the two-inch mark, so that the rails will fit snugly into the corner-posts without any play. There is nothing so annoying in a chair as to have it loose-jointed and rickety.

A wooden seat sixteen inches square, with the rear corners cut out to fit around the back posts, is nailed or screwed fast to the top edges of the upper rails all around; and for the back a twelve-by-sixteen-inch piece is cut and screwed fast in the laps cut at the upper ends of the back posts, as shown in Fig. 2 B.

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To make a comfortable back and seat, cover the wood with curled hair from an old mattress, or some cotton and dried moss; then tack unbleached muslin over it to hold it in place. For the final covering use burlap, denim, cretonne, or other stout fabric, that can be had at a dry-goods store for fifteen or twenty-five cents a yard. Draw it down and turn it under all around the edges of the back and seat, fastening with small tacks driven at regular distances apart.

Large, oval-headed upholsterers' tacks painted black will appear to good advantage if driven about two inches apart along the edge of the goods. If they cannot be had, or are too expensive, a very good substitute may be made from sheet-lead or an old piece of lead pipe split open and beaten out flat.

From the sheet of lead cut disks three-quarters of an inch round with a cold-chisel, on the upturned face of an old flat-iron. With a small hammer beat the edges to resemble

a hand-wrought nail-head, similar to those you may have seen in an old hand-bellows in a blacksmith shop. These are to be painted black, and applied to the wood with slim, steel-wire nails, the heads of which will be invisible if they are driven well into the lead. The heads of the screws that fasten the lap-joints can be hidden with these mock nail-heads, as shown in the drawing.

A good black paint for the metal parts of furniture is made by adding dry lamp-black to some brass lacquer or shellac, so it will have the consistency of cream. It is then applied with a soft-hair brush to the surface of the metal, on which it will dry quickly. It often requires two or three days for oil paint to dry on metals, and it lasts no longer

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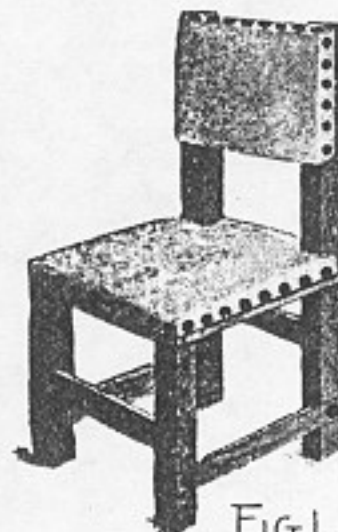


FIG. 1.

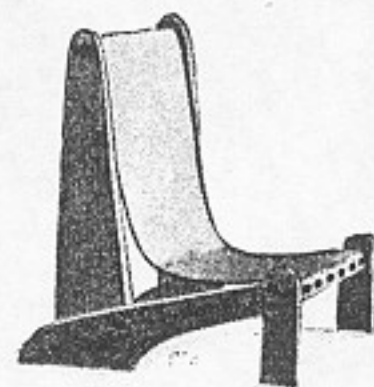


FIG. 3.

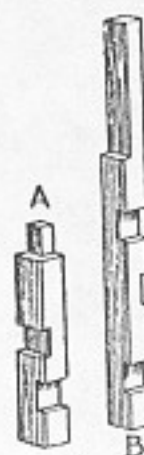


FIG. 2.

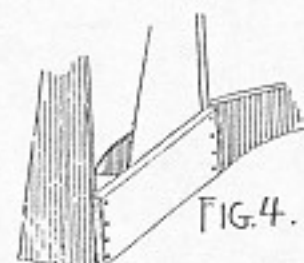


FIG. 4.



FIG. 5.

than the lacquer or shellac coating. Several small nails driven around the edge of the mock nail-heads will hold them in place, and to all appearances they will look like the large-headed, wrought bellows-nails.

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An Odd Chair

For studying or reading, the chair shown in Fig. 3 will be found a useful piece of furniture.

The wood is three-quarters or seven-eighths of an inch in thickness, planed on both sides, and may be finally stained and varnished or painted. The front posts are fourteen inches high and four inches wide, while the back ones are thirty-four inches high, three inches wide at the top, and eight inches wide at the bottom. The side-rails are twenty-eight inches long, three inches wide at the front, and six inches across the widest place near the rear. The side-rails

are fastened outside the rear uprights and inside the front posts, as shown at Fig. 3. At the back, near the foot, the chair is held together with a plate of wood six inches wide and eighteen inches long, screwed fast to the lower edge of the high posts, as shown in Fig. 4.

The top of the rear uprights are bound together with a piece of two-inch curtain-pole, with a saw-cut in the end to the shoulder, as shown in Fig. 5. After it is in place, glue-covered wedges are driven into the saw-cuts to make a key, and so hold the joint securely. Between the front ends of the side-rails a similar piece is placed; or a two-inch square piece of wood, with the front top edge rounded off, may be substituted.

The seat and back is composed of one piece of leather, fabric, or even carpet, caught to the front and top cross-pieces, and adjusted so as to form a comfortable support to the body.

This chair can be made with a shifting back by rounding

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off the lower ends of the back uprights and attaching them to the side-rails with bolts and washers, one bolt to a side. With two or three corresponding holes in the side-rail and upright, pegs can be fitted into them, or a rod passed through from side to side of the chair, in fashion similar to the well-known Morris chair. The pegs must be stout, or the rod substantially heavy, since the leverage is great and would snap off light pegs or bend a thin rod.

A Morris Chair

One of the most comfortable pieces of furniture in a boy's room is a Morris chair, and if properly constructed it should last almost for a lifetime.

Fig. 6 gives a good idea for a solid affair that can be made twenty inches wide and twenty inches deep from outside to outside of corner-posts. The posts are two inches square and twenty-three inches high, and in the front and back ones laps are cut to receive three-inch rails, with the upper edges sixteen inches above the floor. At the lower part of the sides, five inches above the floor, two-inch rails are let into the posts. From these side-rails to the under side of the arms four flat balustrades are mounted and held in position to the lower rails with screws and glue. At the upper end they are mortised into the under side of the arms for half an inch. Two more rails are let into the posts at the inside and on a line with the rails, at front and back, that support the seat and to which the leather is to be attached.

A frame twenty-two inches high is made for the back and covered with leather stretched tight and nailed all around

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the edges with large, oval-headed upholsterers' tacks. The back is hinged to the rear rail of the chair, and held in position with a cross-rod, which in turn is supported by wooden pins driven into the end of the arms, as shown in the illustration. The arms are wedge-shaped, five inches broad at the front and two inches at the rear, where the ends are rounded. They are held to the tops of the corner-posts

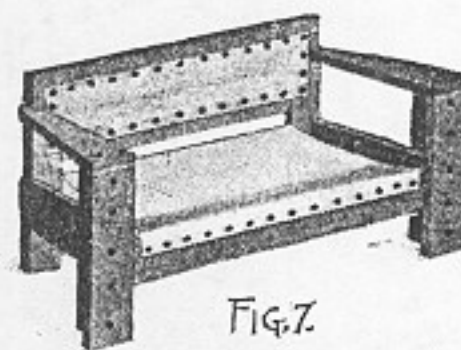


FIG. 7

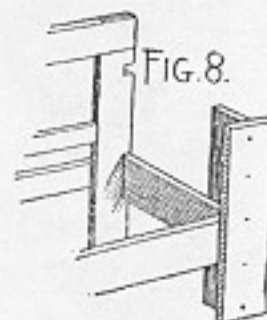


FIG. 8

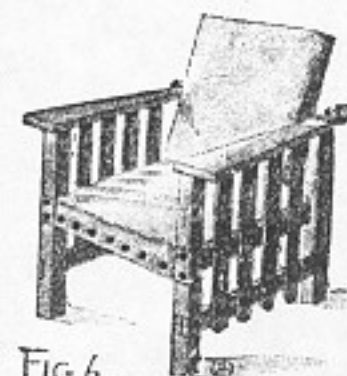


FIG. 6

with long, slim screws, the heads of which are covered with the imitation nail-heads described in the making of the plain chair (Fig. 1).

A Settle

For the side of a room, where there is space to accommodate it, a settle is a comfortable piece of furniture,

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and Fig. 7 gives some good lines that can easily be followed.

The back of this settle is forty-two inches long and thirty-two inches high. The seat is sixteen inches above the floor and eighteen inches deep. The front plates are each six inches wide, twenty-five inches high, and seven-eighths of an inch thick. They are attached to the front and side rails of the settle with stout screws and glue, and a line of screws is driven through the front plate and into the edge of the one it laps against, as shown at Fig. 8, which is one end of the settle frame.

The leather forming the seat is drawn over the front and back rails (which are each six inches wide), and is nailed to the wood, as shown in the illustration. The leather is applied to the back in the same manner, and, to hold the edges down, glue may be used.

A chair may be constructed in similar fashion with the same height and depth dimensions, but twenty-four inches wide over all, the side-plates under the arms being four inches wide.

A Box-desk

In the illustration of a box-desk (Fig. 9) an idea is shown that the young craftsman can easily work out.

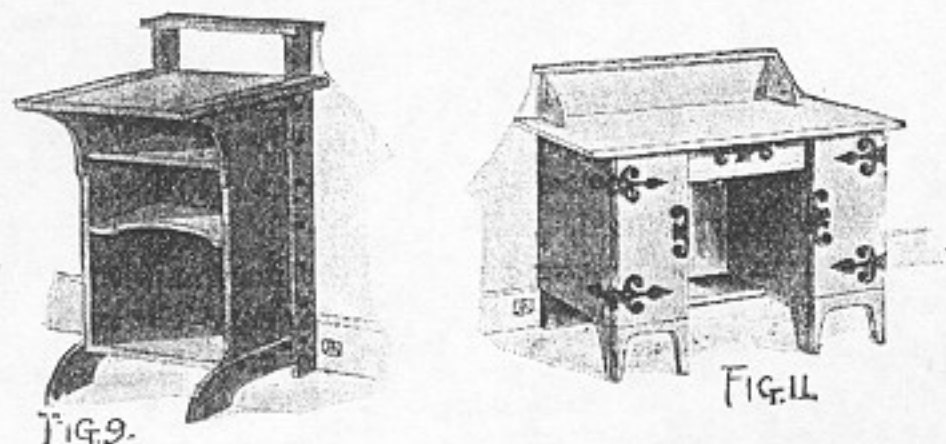
Obtain a box twenty-four inches long, eighteen inches wide, and twelve inches deep. It should be made of planed boards. At the joints drive in a few screws to make them more secure. Cut two pieces of wood thirty-six inches long, four inches wide, and seven-eighths of an inch thick, and attach them to the rear edges of the box when it is stood on

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end, allowing the lower ends to extend down four inches below the bottom of the box. These will form the back feet.

For the front ones, cut two pieces of wood fourteen inches long and six inches wide, rounding off one end, and cutting the bottom out three inches, thus allowing the remaining wood to be three inches wide, as shown at Fig. 10. These are fastened to the lower edges of the box at the sides with screws and glue.

Two shelves, ten inches wide, and as long as the inside width of the box, are to be cut and fastened six inches apart,



leaving a ten or twelve inch space at the bottom for high books, or a place to put the feet when sitting at the desk. A top twenty-two inches wide and eighteen inches deep is made fast to the top of the box, and if a slant is desired the back of the top board may be propped up for an inch or

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two with a strip of wood. On the ends of the side-rails that project above the desk-top a ledge six inches wide may be made fast for ink-bottles, pencils, and other accessories. Attached to the upper edges of the box brackets of wood may be arranged to support the projecting edge of the desk-top.

Stain and varnish, or paint, will add the finishing touch to this box-desk.

A Writing-table

Two boxes, a drawer, and a broad top can be easily transformed into the writing-table shown in Fig. 11. If well put together and decorated with artistic hinge-straps and escutcheons, the boxes are entirely hidden from sight.

Two boxes, each twenty-two inches long, fifteen inches deep, and ten inches wide (outside measure), are placed on end and made fast under a broad top forty-five inches long and eighteen inches wide. Three inches of the top will project beyond the boxes at the ends and front. This will leave a space nineteen inches wide between the boxes. At the bottom a ledge eight or ten inches wide must be made fast to the bottom of the boxes, on which to rest the feet when writing at the table. This ledge will also serve as a brace, and help to hold together the bottoms of the boxes.

Legs six inches high are cut from wood seven-eighths of an inch thick, and fastened under the four corners at the front of the boxes. At the back, the foot-piece is a board ten inches wide, screwed fast to the lower rear ends of the

boxes, so that six inches of it will project down to the floor to correspond with the legs in height. A shallow drawer is

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made to fit between the boxes, and a slide on runners is attached with screws near the top.

Doors ten inches wide and twenty-two inches high are hinged to the outer sides of the boxes, and from sheet-lead the hinge-plates or straps and the escutcheons are cut with a light cold-chisel and mallet, as shown at Fig. 12, A and B. (For other designs, see Chapter VII., on Decorative Hardware.) The front hinge-plates are eight inches long and four inches wide across the scrolls, and the shorter ends are four inches in length. The flat edges that butt against the hinges must be made to correspond with the hinges in width, but they are no part of the hinges proper, being purely for effect. This hardware is coated with the black metal finish. It is then fixed in place with large-headed nails or with steel-wire nails.

A top board, with half-circular supports, can be made and attached to the rear of the desk-top if thought desirable.

A Whatnot

For trinkets, books, and the general assortment of odds and ends that a boy is sure to possess, the whatnot shown in Fig. 13 will be found useful.

It is fifty-four inches high, twenty wide, and twelve inches deep. The cap projects two inches beyond the sides and front. The side-boards are cut up at the bottom, the angle of the coves being ten inches above the floor. Near the top a corresponding effect is obtained by cutting out pieces of wood in the form of shields. The side-ledges are thirty-six inches above the floor, twelve inches long, and seven wide.

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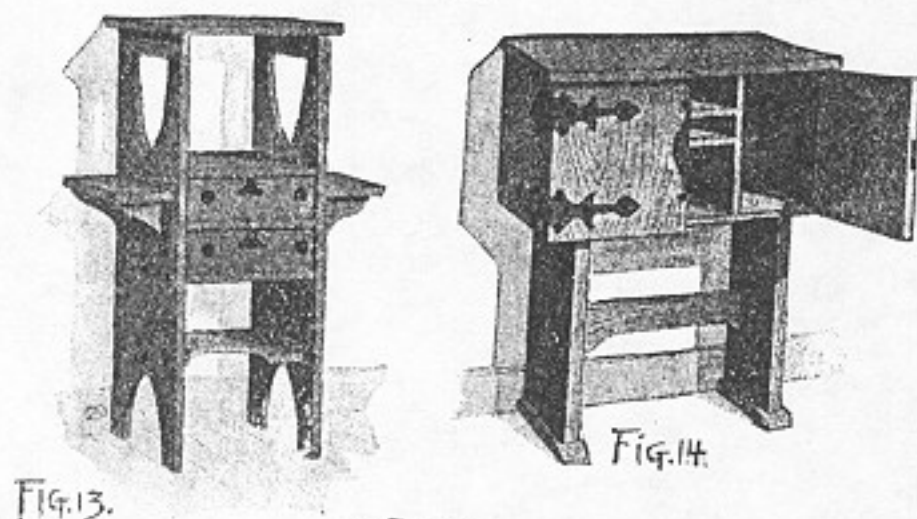


Fig. 13.



Fig. 15.

They are supported by two brackets at each side, five inches wide at the top and six inches deep, cut as shown in the illustration, and made fast with glue and screws.

The ledge over the drawers is forty inches above the floor, and each drawer is five inches deep. The lower ledge or

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shelf is twelve inches above the floor, and the front edge is cut in with a compass-saw.

All the wood-work is of stock seven-eighths of an inch thick, and the edges of the shelves are butted against the side-boards, through which screws are passed, the real heads being afterwards covered with the mock nail-heads. The usual stain and varnish will treat the wood nicely and lend a good finish to this useful bit of furniture.

A Treasure-chest

For stamps, coins, minerals, and other valuable possessions, the treasure-chest shown in Fig. 14 is just the thing.

To give the chest an appearance of strength and security, the doors should be made of wood one and a quarter inches thick, while the legs and feet should be of one-and-a-half inch stock. The box is thirty inches long, eighteen inches high, and twelve inches deep (inside measure), and the top projects an inch and a half over the ends and front when the doors are closed. The legs are twenty-eight inches high and twelve inches wide. At the lower ends feet are cut from wood the same thickness as the legs, and made fast to them with screws. A cross-rail six inches wide and cut in at the under edge is mortised and tenoned into the legs twelve inches above the floor; while across the top of the legs a board twelve inches wide is securely fastened, and braced at the back with a four-inch rail, to prevent this base from racking with the weight of the chest.

Shelves and divisions are arranged, according to requirement, within the chest. To close it, two doors are swung

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on stout hinges, against which lead hasps are mounted to lend an appearance of strength. These are cut from stout sheet-lead, and applied with large-headed upholsterers' nails painted black. The front hasp-ends should be ten inches long and the return ends five inches in length. Over the key-hole a long hasp may be placed, with a corresponding one on the other door to complete the decorative effect.

Studying-table and Stool

For service and comfort when studying or writing, two useful pieces of furniture are shown in Fig. 15.

The top of the table is twenty-four inches wide and forty-two inches long. It can be made from three or four boards of pine or white-wood glued together at the edges and battened at the under side. The front legs should be twenty-seven inches high and two and a half inches square. The rear legs are thirty-nine inches high, and where the table-top joins them laps are cut out on two sides for a depth of one inch, and a corresponding notch is cut from the corner

of the ledge so as to fit into the lap. The lower rail at the back is six inches wide, and the lower side-rails are four inches wide. The shelf attached to the top of the rear posts is seven inches wide and forty-two inches long. It need not be more than seven-eighths of an inch in thickness, and the front ends of it may be supported with short bracket sticks which rest on the table-top close to the rear posts.

At both the front and back brace-strips are let into the legs and the edge of the table, as shown in Fig. 15; these pieces are eighteen inches long and bevelled at both ends.

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To accurately cut the laps in the legs and table-top, lay a strip across in the proper place, and mark the lines with a pencil; then with a saw cut slowly and accurately on this line to the proper depth. With a chisel cut the wood away and let in the brace-strips, when they can be securely fastened with glue and screws. At both ends shelves may be attached to the posts and the braces, as shown in the illustration. These will make good book-ledges or convenient places for pencil and pen boxes, extra pads, and school trappings. Books may rest on the table under the top shelf. To prevent their falling off at the back, a rail two inches wide is attached to the rear posts and supported at the middle by a short upright block which also acts as a brace to the middle of the top shelf.

The stool is eighteen inches high, sixteen inches long, and fourteen inches wide. The corner-posts are two inches square, and the rails are two inches wide and three-quarters of an inch thick. At the sides the top-rails support the seat, which is a piece of cowhide attached with nails and glue, over which imitation nail-heads are made fast. The lower rails, at front and back, are three inches above the floor, and the lower side-rails are eight inches above the floor. Stain and thin shellac will finish this wood-work nicely.

Chapter XIX

PAINTING, DECORATING, AND STENCILLING

THERE are very few crafts that a boy takes hold of with so much confidence as painting. In the average boy's mind it merely means getting a pot full of paint, a brush, and daubing it on. This is painting in one sense of the word, but not painting as a real craftsman should do it.

Good painting is a skilled trade, just as are horseshoeing, plumbing, or bricklaying. But this manual is not intended to be an artisan's guide; all that can be done is to lay down certain principles, and to give the practical hints that may make a boy's efforts in this line worth while.

It is not necessary that a boy should know how to make paints; that is a branch of manufacture that requires years of experience, improved machinery, and chemical and mineral formulæ. A boy should know, however, what paints are made of, how prepared, and how they are mixed, so that he will be able to work with intelligence and success.

The basis of all good paint suitable for wood-work is lead

or zinc. Some painters prefer all lead for outside work, while others take two-thirds of lead and one-third of zinc, and then add the coloring dust or ground colors to get the required shade. Both white-lead and zinc are ground in

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linseed-oil, and can be purchased in cans, or kegs, ranging in weight from one-pound tins to five-hundred-pound kegs. Zinc is sold in the same kind of packages, and the cost in small quantities is about ten cents a pound. Inside shades of any color are generally made of two-thirds zinc and one-third white-lead; then the dust or ground colors are added to tone down the white to any desired shade. Pure boiled linseed-oil and good turpentine should be used to thin paints. Benzine, naphtha, kerosene, or other oils should never be used in the preparation or thinning of paints unless for special purposes.

To make the best paint for outside use, take two pounds of white-lead and one pound of white-zinc, and mix them thoroughly, adding whatever oil is necessary to render the mixture about the consistency of rich cream. If coloring matter is to be added, it is best to use the ground colors rather than the dry dusts, because the colors ground in oil are much finer, and will mix better with paint than the dusts. Colors ground in oil may be purchased at a paint store for ten or fifteen cents a pound. A portion of the color should be thinned first with turpentine, and then added to the pot of mixed white, stirring the mixture while the coloring is added.

If the paint should not be thin enough to lay on the wood, you may add small portions of turpentine until it is the right consistency. A little experience is the best teacher in this matter, and to make sure, it is well to ask a painter. Painters, and all masters of arts and crafts nowadays, are much more easily approached than they were a few years ago, and a boy who really wants to know, and who goes

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about it in the right way, can generally get the knowledge or advice he is seeking. When making paint for inside use, take the proportion of two parts of zinc to one part of lead, then mix and thin with oil to the consistency of rich milk or thin cream.

Before new wood-work is painted, all knots or sappy places should be given a coat or two of shellac to "set" the sap. The priming, or first coat, should be composed of equal parts of boiled linseed-oil and white-lead for outside, or zinc with some turpentine for inside work. When this is dry one or two coats are to be laid on, taking care to apply the paint evenly and to work it into all cracks, crevices, and corners. The secret of good work is not in daubing a whole lot of paint on the surface to be covered, but in laying it on evenly and in a thin coating, so that it will neither gum nor run. Two or three thin coats are always better than one thick one, and the extra time spent in putting the thin coats on, and in going over the work several times, will be amply repaid, because the work will last. The thick coat will dry unevenly, and in time will chip, crack,

and peel off.

When painting over old wood-work, it is always best to scrape or remove as much of the old paint as possible. Then sand-paper everything smooth, and wash all surfaces of painted wood-work with a sponge and sapolio, or other good scouring soap. If there should be any glossy surfaces to the wood-work it is best to give them a washing with a very strong solution of washing soda. A saturated solution of the soda is best. This is made by adding washing soda to water (about a pound to two quarts), and mixing or stirring

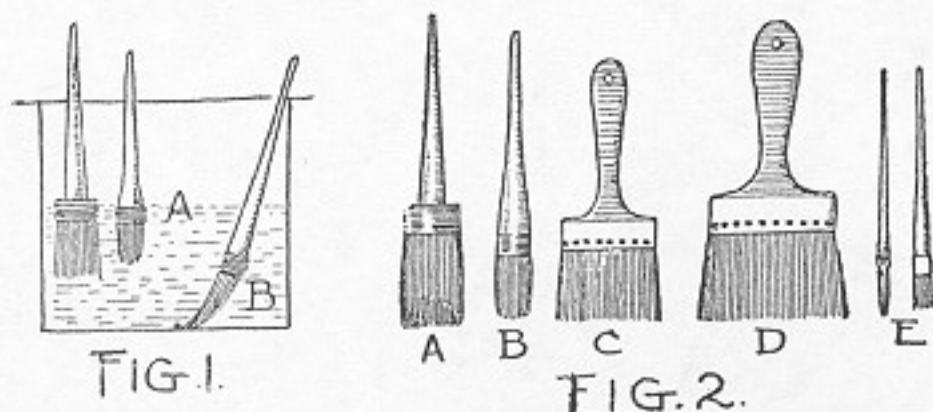
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it until the water has taken up all the soda it will hold. After the soda-water has been applied to the wood-work, be careful to wash it all off with clear water, changing the bucket of water frequently, so that no traces of soda will be left on the wood-work. Follow these directions explicitly, and do not try your own way nor trust to luck to have the new job look well and last. There is an old saying that "A little putty and paint hide a multitude of sin," but get rid of as much of the "sin" as you can before the new coat is put on. The soda bath is particularly necessary on old furniture that has been varnished several times. Paint will not hold on varnished surfaces unless the varnish is first cut with soda-water or some of the prepared paint and varnish removers.

It is always best to mix your own paints rather than to purchase "ready-mixed" paints or "prepared paints" at a store. There are, of course, a great many reputable makers of mixed paints, and you may use their preparations if you so desire. But my advice to the young craftsman is to purchase the raw materials of a good dealer and learn how to mix his own paints.

When you have finished using your brushes they should be washed out—first with turpentine, then rubbed out in kerosene oil and laid away for future use. If they are to be used again within a few days, it will not be necessary to wash them out, and they may be allowed to stand in water. Bore a hole through the handle, and slip through a stout wire so that the ends of it will rest on the top edge of a can. The brush should then be placed in the can so that it will hang on the wire but not touch the bottom, as shown in Fig. 1.

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Then water is put in until it just covers the bristles, as shown at A. Never drop a brush into a pail or can of water for even so short a time as overnight. The brush sags and causes the bristles to curve, as shown at B, and it is then

a hard matter to get them straight again. The several kinds of brushes that a boy will need for his work are shown in Fig. 2. A is a regular wire-bound bristle brush which can be had at a paint or hardware store in several sizes; B is known as a "sash tool"; C is a flat floor or varnish brush; D is a sizing, kalsomine, or whitewash brush; and at E a round-liner or stipple brush and a flat tool are shown. For light work the tin-ferruled, cedar-handle flat bristle brush can be had in sizes ranging from one to six inches in width.

There is nothing that freshens up a room so much as repainted wood-work, newly papered or tinted walls, and kalsomined ceilings; and while it may not be possible for a boy to become an expert paper-hanger, it is quite within his ability to tint walls and ceilings, paint wood-work, and varnish the floors. If he has any artistic faculty whatever

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he can do a great deal of effective decorating, and this is a subject that we will now discuss at greater length.

Decorating

There is no secret in the art of decorating. Good judgment, good craftsmanship, and common-sense, coupled with the use of the best materials, will always bring about good results.

The schemes that are shown in the illustrations on the following pages are those that any boy can carry out; and with a fair knowledge of carpentry, painting, and other crafts he will find it an enjoyable task to change his room into one containing characteristic features of his own invention or creation.

A very simple effect is shown in Fig. 3, and for this room it will not be necessary to remodel or change any of the wood-work. After removing all old paper from the walls with hot water and a sponge (and cleaning off the ceiling also), the walls and ceiling should be given a coat of size. This is made by dissolving a handful of good ground or flake glue in a pailful of water, and then painting it on the wall with a wide brush. Do not slop the size over the floor, nor have your brush too wet with the glue-water when you are using it. Try to work it in well rather than attempt to lay it on thick. When it is dry you can kalsomine, paper, or tint over the walls, and the size will help to hold the covering material in place. The wood-work in this room is painted white or a light shade of any color that is easily washed and kept clean. If paper is to be used on the side

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walls, some very good patterns can be selected at a stock house that will not cost more than twenty-five cents a roll.

The pattern shown in this scheme is in stripes and running vines. Above the picture-moulding the wall is tinted or papered with a light-buff paper. With some apple-green fresco-paint the laurel-bush tops are drawn in above every other stripe, if they are wide enough apart. This makes a good finish to broad stripes that would otherwise stop at the moulding. A small desk can be built in one corner.

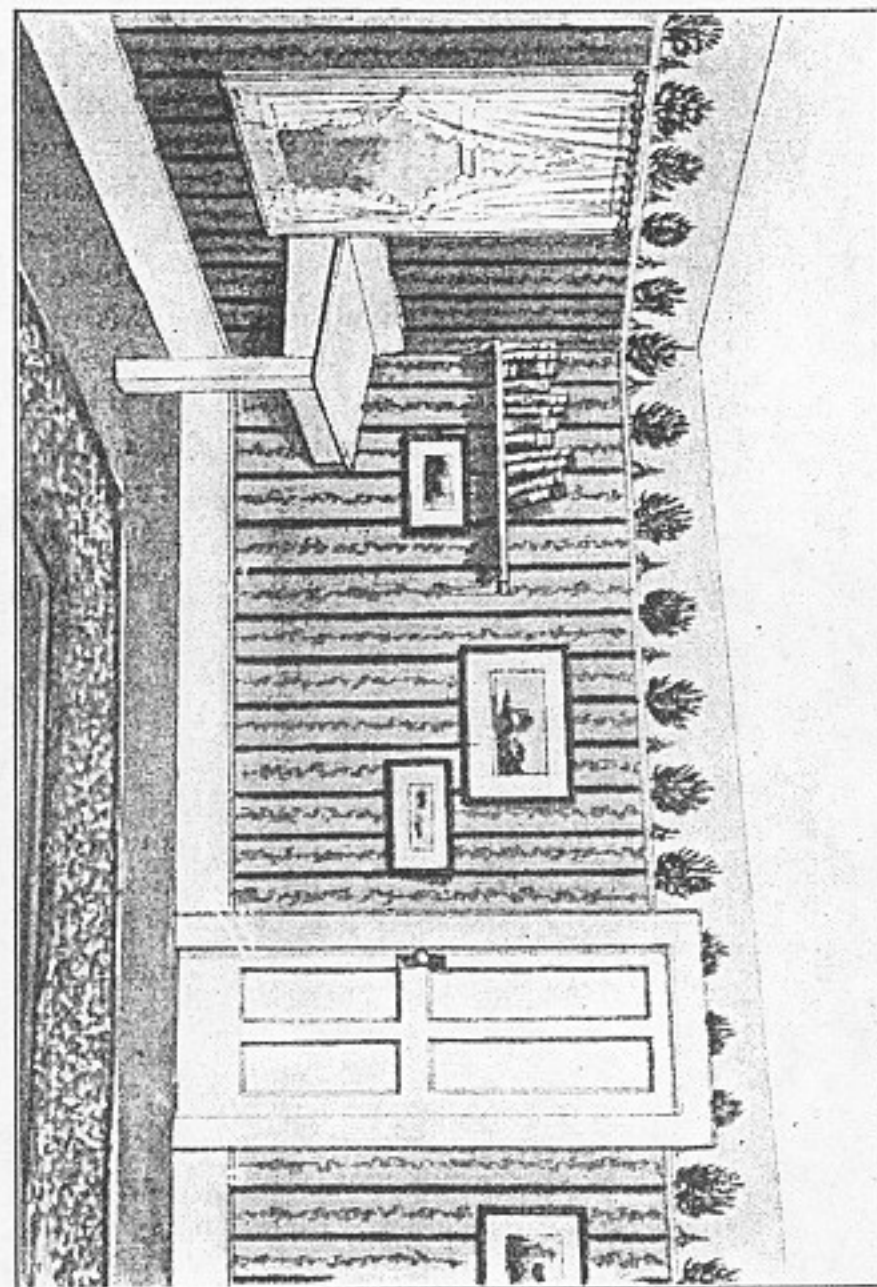


FIG. 3—A BOY'S ROOM

It has a hinged top, and within it writing-materials may be kept. Above the desk a book-ledge may be attached to the wall with two brackets. Simple curtains at the windows and a painted or stained and varnished floor, with a carpet rug at the centre, will complete the decorating of this room. The cost should not exceed ten dollars.

Decorating a Bedroom

Of the many attractive schemes for the decoration of the bedroom, there are none so pleasing and lasting as the plain paper and an ornamental frieze.

A full-pattern paper soon becomes tiresome, and while there are thousands of pretty figured papers adapted to bedrooms, at least one-half of the bedrooms in our homes are overdone or poorly papered. Small figures and as nearly neutral shades as possible should be used, as they are restful to the eyes, particularly in time of sickness. In Fig. 4 a pleasing scheme is shown, and while its beauty lies in its simplicity, it is quite as inexpensive as it is attractive.

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Pink is the general tone, and the wood-work is painted cream color or light ivory. Four feet and six inches above the floor a rail is run around the room, and between it and the surbase vertical strips are made fast to divide the

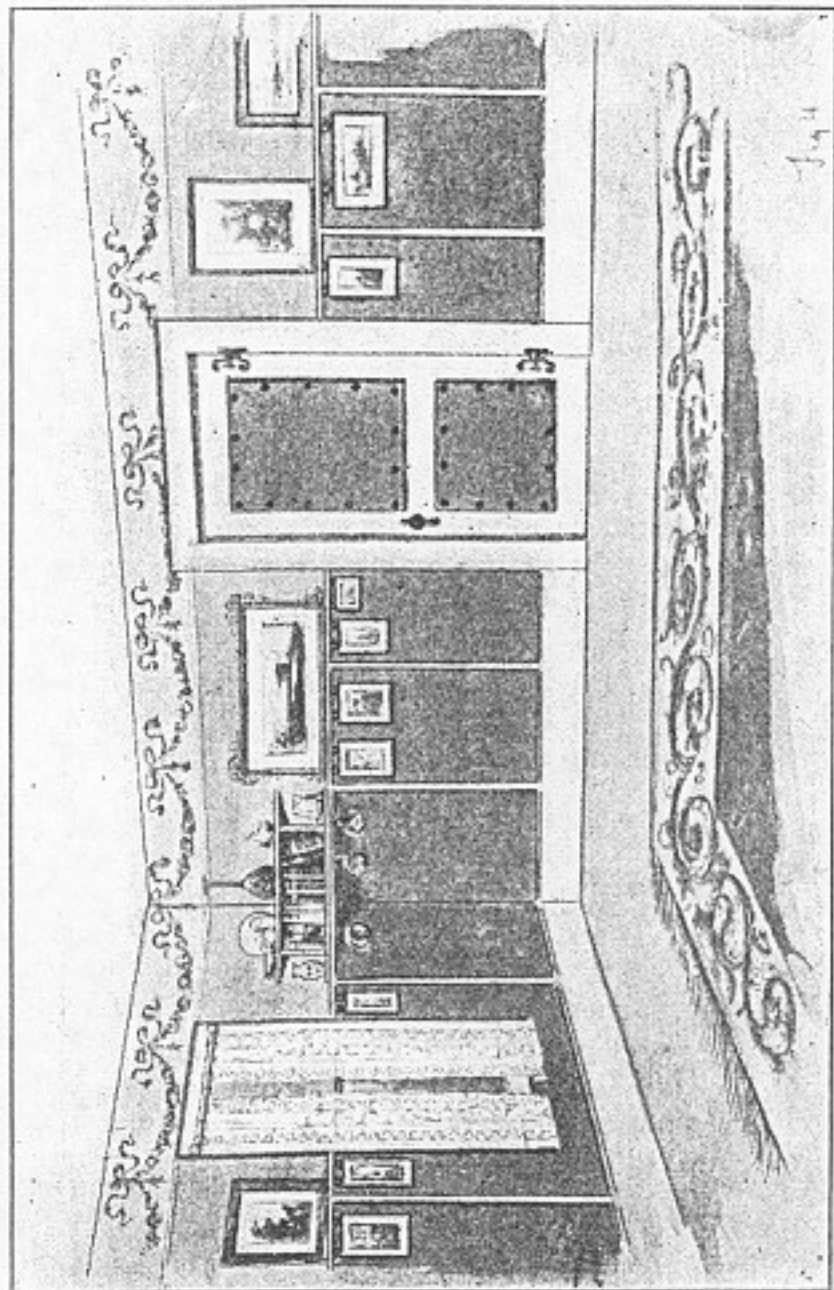


FIG. 4—A BEDROOM

wainscot into panels.

Plain cartridge or ingrain paper is hung on the wall above the surbase, and between the rail and picture-moulding a lighter-pink paper is applied. This may be a finely figured paper, or a narrow, satin-striped paper that can be had at twenty-five to fifty cents a roll. A border paper with garlands and ribbons, to match the shade of the others, may be had by the yard or roll in several widths. Light shades of soft green or robin's-egg blue, with white wood-work, always make an effective and cheerful combination.

An artistic effect for the door may be secured by making thin panels for the upper and lower sections, and covering them with a fabric or burlap as near the shade of the paper as it can be matched. These are attached to the door with a few large, oval-headed nails painted black. Sheet-lead escutcheons and hinge-straps can be made and applied to the wood with oval-headed upholsterers' nails painted black. Any other metal-work in the room is to be coated black.

Pink, black, and cream, or pale-green, black, and ivory color make pleasing and cheerful combinations for bedroom decoration, and they do not become tiresome.

A feature in this scheme is the mode of suspending small pictures from the rail by means of harness-rings and large-headed nails painted black. The larger pictures hung above the rail are arranged so that the bottom of each is on a line with or touches the rail.

A Boy's Room

The arrangement and scheme for one side of a model boy's room is shown in Fig. 5. In this attractive room the wood-work is white, or very light in color, and the walls a soft, light-tea or olive green. The border above the picture-moulding is a light shade of old pink ingrain paper on which the wreath and garland border is painted in fresco colors or stencilled.

At one side of the room a generous chest of drawers can be built in a corner, and three feet up from the floor a long drop-ledge may be made fast to the wall and arranged so that hinge-brackets will support it. When not in use for drawing or studying, the brackets can be folded in against the wall and the ledge dropped down. Above this ledge, and extending from the chest of drawers to a window or door, a compartment-nest of shelves may be made from three boards with shorter ones for partitions. This is supported every two feet of its length with brackets screwed securely to the under side of the bottom shelf and to the wall. At the top it is also secured with small strips of metal screwed fast to the back edge of the top shelf, and through which screws pass into the wall. Short curtains of some light material may be hung from a wire stretched along the under side of the top shelf and caught up to it in one or two places with staples.

The floor in a boy's room should be of stained and varnished narrow boards over which a rug can be thrown. This makes it possible for the outer edges of the floor to be wiped up frequently, and does not allow dust to settle at

the corners or edges as it would in a carpet. All the metal-work, such as gas-brackets, hinges, hasps, escutcheons, handles, and catches, should be given a coat or two of black finish, which will lend them the appearance of being wrought iron.

Another Boy's Room

The panelled wainscot in Fig. 6 is formed of vertical strips of wood four inches wide and four feet high, mounted above the surbase. On top of these a six-inch band of wood is carried all around the room, on which a five-inch ledge is mounted, the latter being supported on brackets which line with the centre of the vertical strips. The doors, door and window casings, surbase, and wainscot-rails are painted white, and all the hardware is black.

Hinge-straps of lead are cut and fastened to the doors and casings with large, oval-headed nails. To cover the panels in the doors, one large panel is made from thin wood. It is covered with burlap and nailed fast to the side of the door facing the room, with large-headed nails, or mock nail-heads not less than one inch in diameter. Four-inch ledges are placed over the door and window casings. These are supported by brackets at the ends that line with the middle of the casing uprights.

The walls above the wainscot-ledge are papered, and the panels in the wainscot are covered with burlap glued to

the wall. The burlap on the panels and doors may be in a coffee or light-brown color, and the paper should then be a light shade of old green. The ceiling is tinted light buff.

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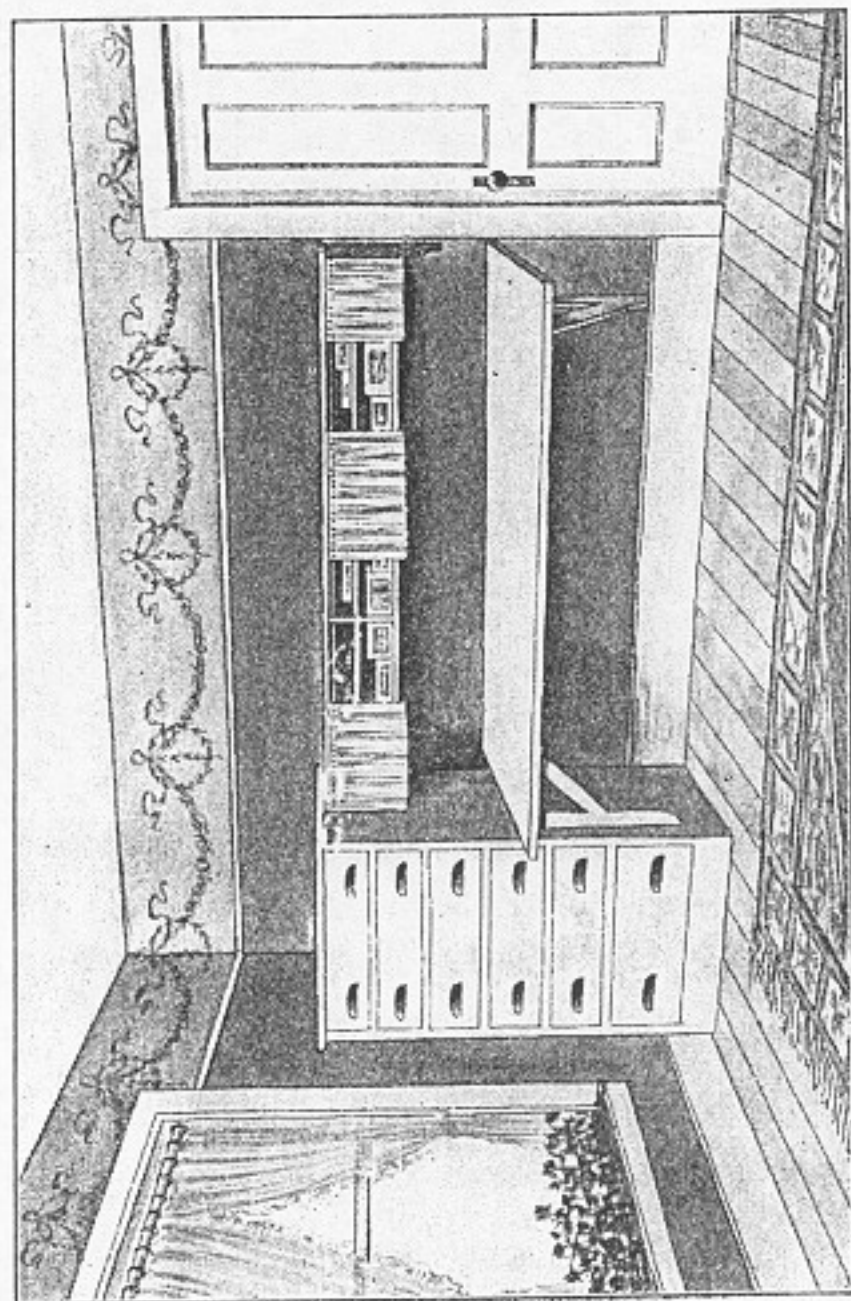


FIG. 5—A BOY'S STUDY ROOM

A Nursery

If a boy has some younger brothers or sisters, he can fix up their room or nursery in some such manner as shown in Fig. 7. The walls are to be cleaned and sized; then the wood-work is painted white, and a toy ledge or rail is made fast with small brackets, two feet and six inches up from the floor, or about on a line with the window-sills.

The lower part of the wall is to be covered with dark-colored burlap, and above the ledge a lighter-colored burlap or denim is applied with heavy paste, to which a handful of glue has been added.

Another but narrower rail is made fast to the wall about on a line with the middle rib of the windows. Above that the walls and ceiling are painted in imitation of the blue sky with fleecy white clouds floating about. Paint in some birds flying in the air, and one or two perched on the tops of the window and door casings. If this work is well done it will have a very realistic appearance. Pictures may be hung above the toy ledge and under the top strip by means of large rings painted black.

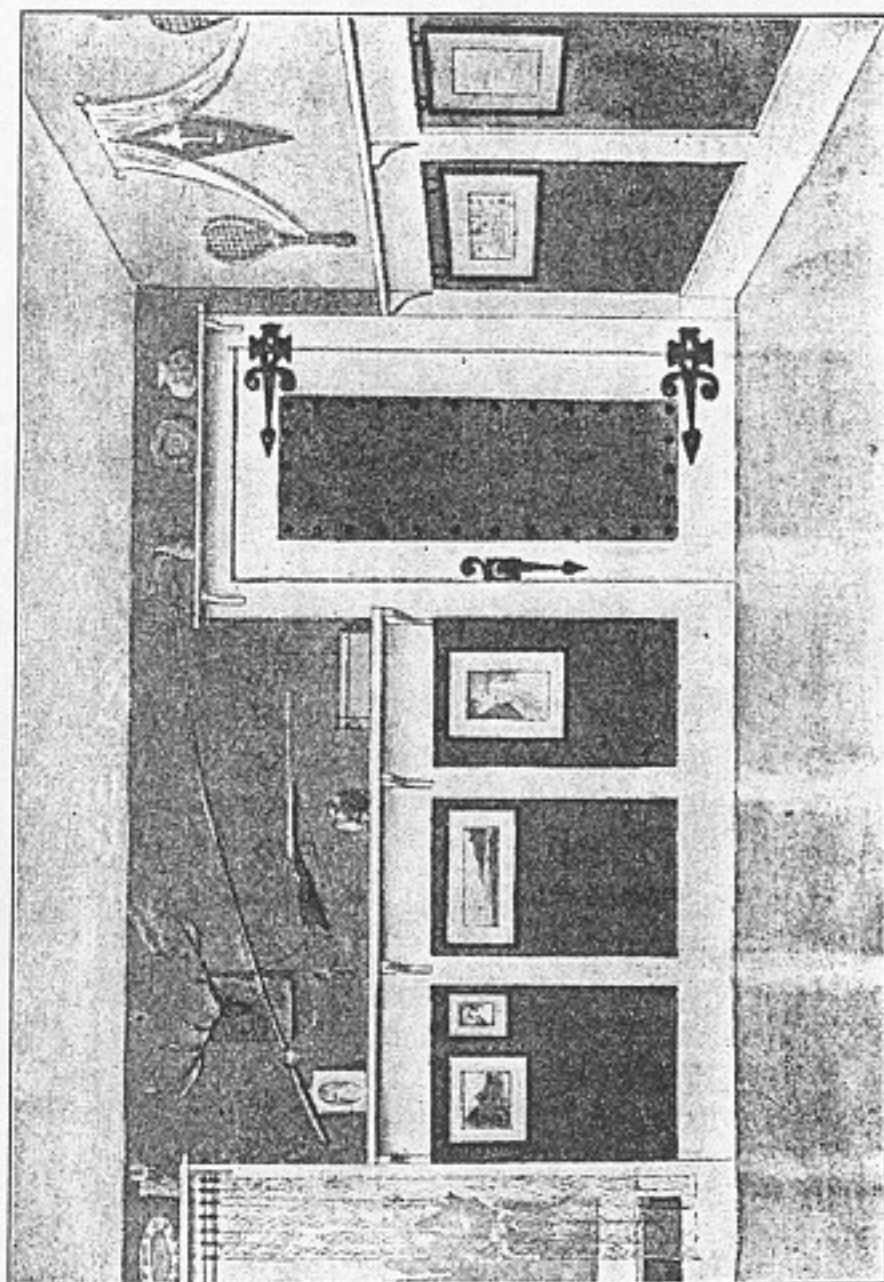


FIG. 6—ANOTHER BOY'S ROOM

Stencilling

The art of stencilling, although a very old one, is constantly being revived through the efforts of amateur craftsmen. Many of the art textiles now to be had in the art and dry-goods stores have printed patterns in imitation of this style of decoration. Nothing in the way of machine-printing, however, can equal the hand-stencilled fabrics.

Simple figures are easily stencilled on fabrics, papers, or

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walls, and the beginner will be wise in using the small, clearly defined figures; then, as proficiency is acquired, the more intricate and ornate patterns and designs may be employed. Every young craftsman should cut his own stencil-plates from fibre or oil-board. It should be about the thickness of two ordinary calling-cards, and stiff enough to hold its shape. The design is drawn directly on the material, or on a piece of brown paper, and then transferred to the board. With a sharp knife-blade the outline is carefully cut, taking care to leave the bridges which are necessary to hold the parts together. This is clearly shown in Fig. 8, which is a small stencil for a fleur-de-lis. In Fig. 9 A the effect is shown after the pigment has been applied to the fabric or wall. If the ornament had been printed or stamped, however, it would have been made without any breaks, or as shown in Fig. 9 B.

Fresco colors should be employed for stencilling on walls,

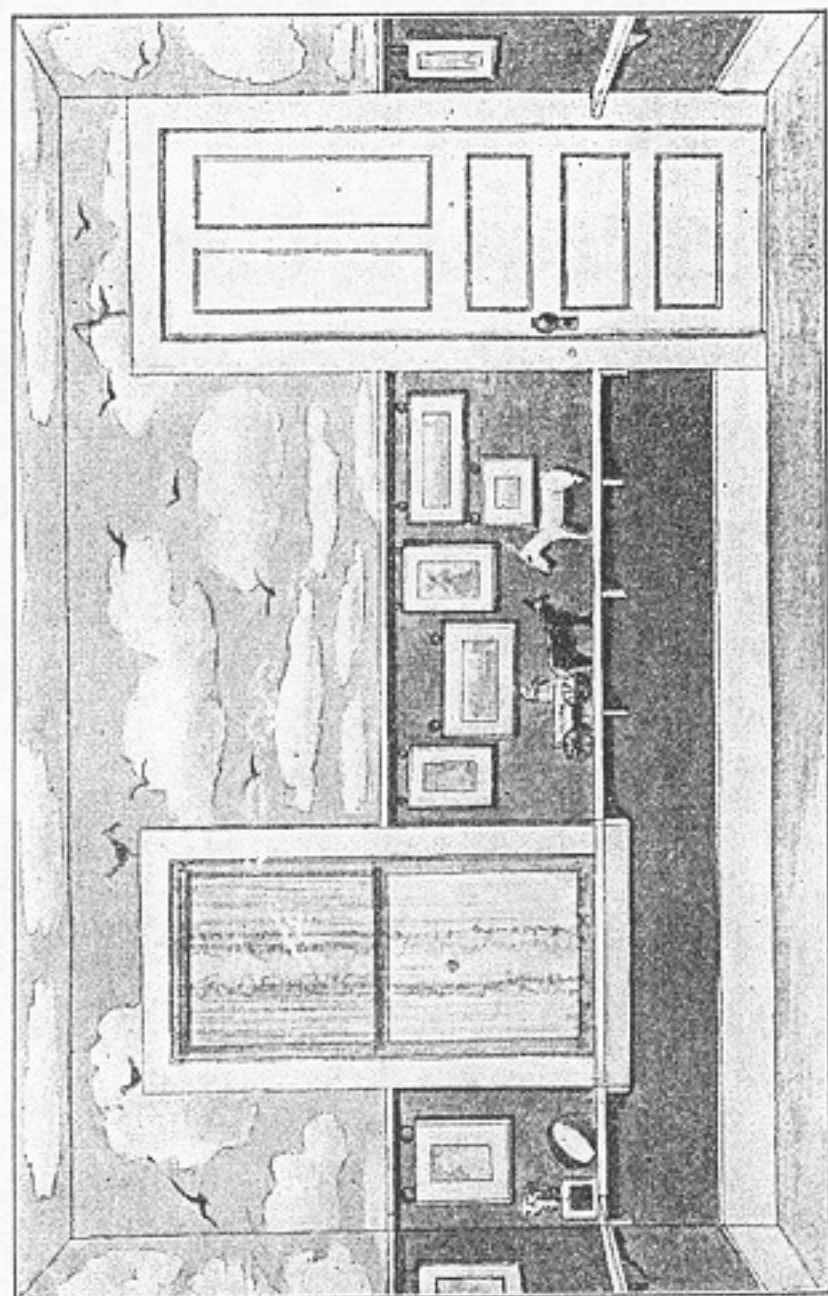


FIG. 7—A NURSERY

but on fabrics aniline colors or diluted oil-paints may be used to good advantage. When preparing colors for fabrics, the tube oil-paints, or body colors ground in oil, should be employed. They should be thinned with benzine, and placed in the bottom of a dish or saucer, so that the stencil-brush will take up the colors at the tip ends of the bristles. Fresco colors for walls should be used thick, or about the consistency of rich cream, while those of oil or aniline need not be thicker than milk. Regular stencil-brushes must be used for this work. Such brushes may be had at any paint store, and will appear as shown in Fig. 10. Stencil-brushes are round, something like a shaving-brush, but the bristles are stiffer and are stubbed or cut square at the ends.

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When cutting your stencils, keep turning the oil-board so that you always make the cut towards you. Lay the material on a smooth piece of close-grained wood, or a sheet of zinc, and hold your knife with the blade in a vertical position, and not to one side or the other. Do not

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make bevelled cuts. Straight ones are necessary or there will be smeared edges.

For a stencil-plate to make the garland and ribbon border shown in the frieze of the room (Fig. 4), a one-half section only is necessary (see Fig. 11). The full length of a garland is marked on the wall by indicated dots, with chalk or pencil; then the half garlands are stencilled all around



FIG. 8.



FIG. 9.



FIG. 10.



FIG. 11.



FIG. 12.



FIG. 13.

the room. When completed, the stencil-plate is carefully wiped off; then it is reversed and the remaining halves are done. The stencil-plate for the wreath ribbon and garland border shown in the room (Fig. 5) is illustrated at Fig. 12. This is a half garland and wreath, and is used as described for Fig. 11. The stencil-plate shown in Fig. 13 can be used as the frieze or border in Fig. 6. This is an empire design, and its dignity and beauty make it a fitting ornament for any room in a house.

Chapter XX

NOOKS FOR BOOKS

THERE is always a demand in the house for convenient places in which books, pamphlets, magazines, and papers may be kept, thus avoiding the necessity of scattering them over tables and shelves that are properly reserved for other things. Regular bookcases are suitable for a library, arranged especially for the purpose of harboring books, but for the sitting-room, bedroom, or hall the odd rack, shelf, hanging cabinet, or convenient nook is an acceptable addition to the ordinary furniture.

Among the following illustrations may be found a variety of ideas in book receptacles. Any of them can be made at home by the boy craftsman, of inexpensive materials that may be at hand, or cheaply purchased from a carpenter.

All of these designs are entirely practical, and may be constructed with the aid of ordinary tools, the joints, laps, and matched edges being of the simplest forms. The staining, decorating, and finishing of these pieces of odd furniture are easily within the average boy's ability, and if

the instructions are carefully followed the results should be most satisfactory.

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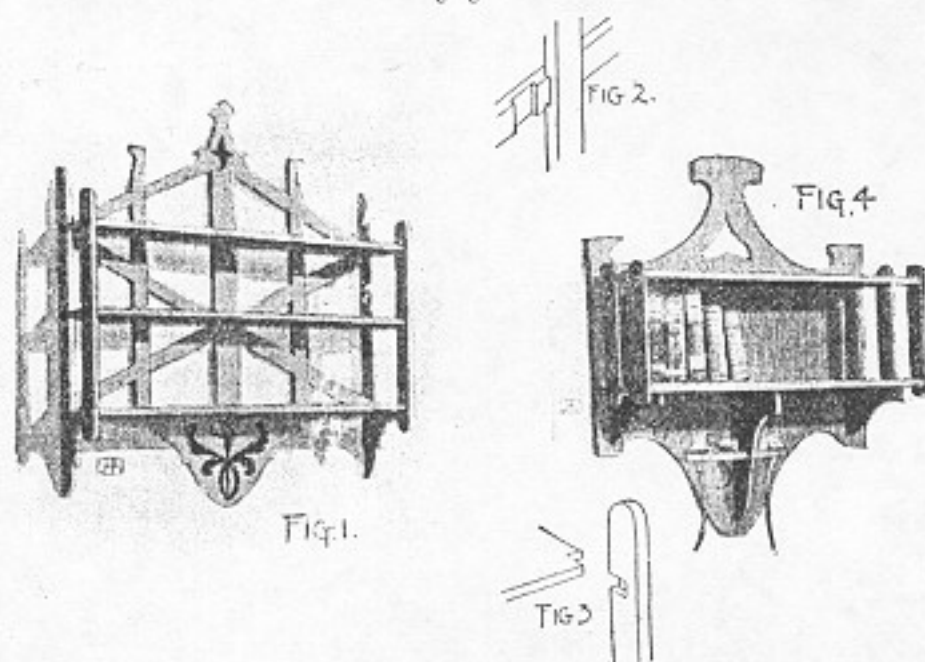
A Wall-rack

Of these designs the wall-rack (Fig. 1) is perhaps the easiest to construct, since it is formed of but three shelves and some narrow rails.

A convenient size will be from twenty-seven to thirty-six inches long, twenty inches high (from top to bottom shelf), and eight inches deep. The extreme height from top to bottom, along the middle wall strip, is about thirty-eight inches. The wood should be three-quarters of an inch in thickness, planed on both sides, and free from knots or sappy places. The strips, excepting the centre-piece at the back, measure two and a half inches in width, and where one crosses another a lap is cut in each, as shown in Fig. 2. This may be done with a fine saw and chisel, and the joint held firmly with glue. Where the shelves join the uprights at the ends a groove is cut in the end-rails to receive the ends of the shelves, as shown in Fig. 3. The curved sections of the rails, the back-board, and the tops of the upright strips at the back should be cut with a compass-saw and afterwards sand-papered or dressed down with a wood-file. All the edges of the wood-work should be rounded by means of a small plane or sand-paper, since sharp corners are not desirable on useful furniture.

Long screws should be driven through the end-strips and into the ends of the shelves to hold them firmly in place. To cover the screw-heads and lend them the appearance of being large, wrought-headed nails, false heads should be made from scraps of thick sheet-lead and attached to the wood with slim, steel-wire nails. To make these heads,

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disks three-quarters of an inch in diameter are cut from sheet-lead with a cold-chisel and mallet, the work being imposed on the upturned face of an old flat-iron. With a light hammer the edges are beaten to give them the appearance of anvil-made nails, such as were used years ago in decorations, and on antique chests, doors, leather-covered furniture, and walls laid in tooled leather. These

nails were hand-made, and crude but artistic in appearance; they are always effective when used in connection with leather and wood-work.

The ornament under the lower shelf of the rack is drawn on the bare wood, and tinted in colors to match the natural flowers and leaves. Use oil-paints thinned slightly with

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turpentine, so as to give the appearance of a stain or dye rather than of an opaque color. All the wood-work is then stained some desired shade, and the outline of the ornament is either burned pyrographically or lined with dark-brown paint in imitation of a burned line. A bluish-gray is a pretty color for this wall-rack, and it can be made by thinning Payne's gray and adding a small proportion of any good blue, such as cobalt, ultramarine, or cerulean. The stain should be applied thin, with a flat brush, and then partially wiped off with a soft rag. When dry, a coat or two of shellac will give a lustre to the stain, hold the color, and render an egg-shell gloss to the wood-work. (See Chapter XII. for instruction in Pyrography.)

A Book-nest

A book-nest of quaint shape is shown in Fig. 4. It is formed of a back-board, two shelves, three brackets, and two slats that connect the shelves at the ends. This is a small piece of furniture and is intended to fill a small space; it should be from eighteen to twenty-four inches long. The shelves should be ten inches apart, and the under side of the lower one is supported by a long bracket, at the middle of which small corner shelves are arranged, as shown in the illustration. Holes may be made in these brackets, through which the stems of pipes can be inserted. The curved parts of the wall-plate are cut with a compass-saw and finished off with a wood-file.

It is not necessary that this home-made furniture should be absolutely smooth or the lines perfectly straight. A

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slight variation from the manner in which shop-made furniture is constructed adds to the effectiveness of these book-racks and holders, and gives them the rough-and-ready artistic appearance that is characteristic of the "mission" and other popular styles of modern craftsmanship.

Another Book-rack

A simple arrangement of shelves in the form of a book-rack is shown in Fig. 5. Where there is room to accommodate a small standing receptacle of this nature, this design will be found both useful and ornamental.

The top shelf is about forty-two inches high from the floor, and in width the rack may be made to fill the available space, say from two to four feet. The corner-posts are of wood two inches square, and where the shelves are attached portions of the wood are cut away, as shown in Fig. 6. The shelf corners are cut out in such a manner that half an inch of the shelf edge enters the post, where

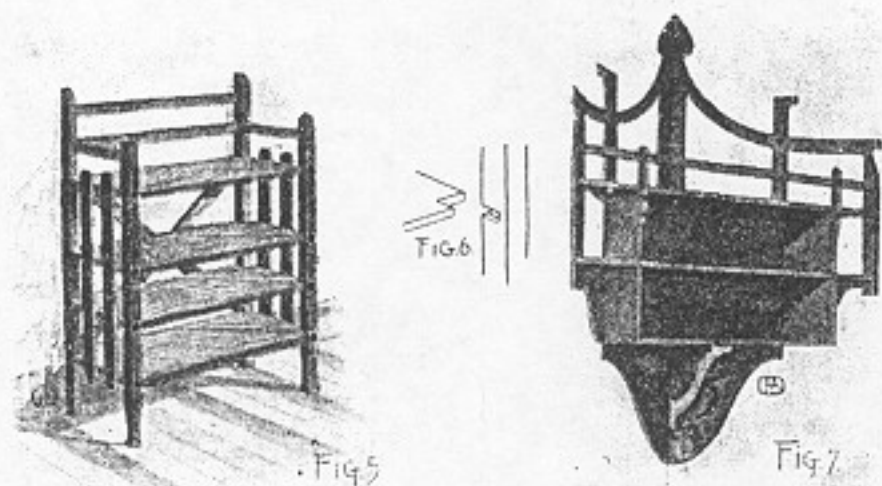
it is held in place by means of glue and screws.

The screw-heads are covered with false nail-heads of lead. These, when finished, should be painted a dead black in imitation of wrought iron. An old green or a weathered oak color would be appropriate for this rack.

A Corner-nook

For the corner of a room where space is valuable an idea is suggested for a corner-nook (see Fig. 7). This is nothing more than a well-made box arranged with wall-plates that

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extend down below the bottom of the box, and to which the ornamental wood-work over the box is attached.

The wings, or angle-shelves, and the brackets at the sides should be made to conform with the general proportions of the design. The working construction is so clearly shown that it is not necessary to minutely describe the smaller details. The shelves should be nine inches apart, and the width of the box must be governed by the space that can be allotted to it. The ornament at the bottom of the wall-plate is painted on, and then outlined with a dark-brown paint or burned. The wood-work is tinted an olive-green, or other desirable color, then shellacked.

A Book-tower

An odd but useful piece of furniture is shown in the illustration of a book-tower (Fig. 8). It is suitable

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for the corner of a room where the available space is limited.

This tower should be twelve or fourteen inches square and about seven feet high. The corner-posts are two inches square and the shelves three-quarters or seven-eighths of an inch in thickness. The shelves are let into the posts (as shown in Fig. 6) and securely fastened with long screws. The side slats are of thin wood. They are let into the edges of the shelves, where they may be fastened with glue and long, slim, steel-wire nails. Each joint or attachment should be finished with a lead nail-head, which should be painted black.

A very good dead-black paint for metals is made by thinning shellac to the consistency of milk, then adding

some dry lamp-black until it is about the thickness of cream. This is applied in thin coats with a soft, flat brush. If one coat does not thoroughly cover the metal, another may be applied after the first one is absolutely dry.

Around the top of this book-tower a rail is arranged three or four inches above the top shelf, to serve as a guard for articles of bric-à-brac placed thereon. With the arrangement of slats shown in the drawing, the books are distributed in such a manner that the titles may be read from both directions instead of from one side only.

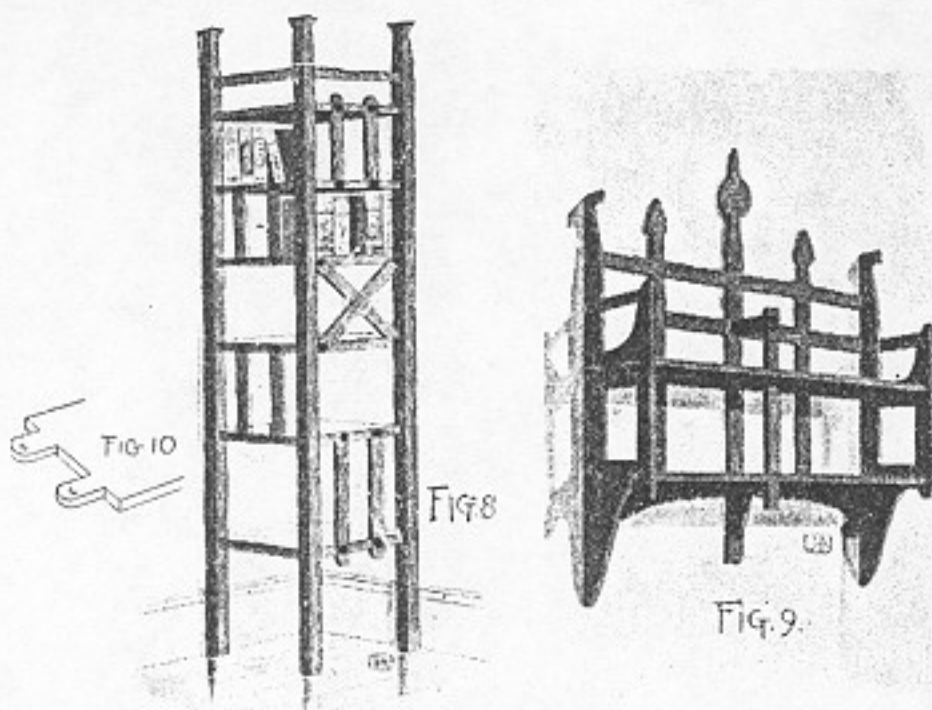
Hanging-shelves

A unique design for hanging-shelves is shown in Fig. 9.

For general use the rack should be thirty inches long, the ends thirty inches high, and the shelves seven inches wide.

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The space between the shelves should be ten or eleven inches, while the total height of the middle back strip is thirty-six inches. The other parts should be made in proportion to the drawing, and where the shelves join the sides mortises should be cut, through which to pass tongued ends, the latter being fashioned on the shelf ends, as shown in Fig. 10. With a brace and bit holes are made to receive wooden pins, or keys, that will lock the wood-work together.



Olive-green will be an appropriate color for the wood-work. When attached to the wall, care should be taken to anchor it firmly and with heavy screws to the studs behind the plaster.

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A Book-castle

In the design for a book-castle (Fig. 11) the shelves and rails are arranged in such a manner that books may be slipped in from the front and also from both sides. The lower shelf is devoted to large volumes, portfolios, or serial publications in large sheets. The top shelf and the one under it are for volumes of medium size, while the small deck above the shelves makes a convenient receptacle for

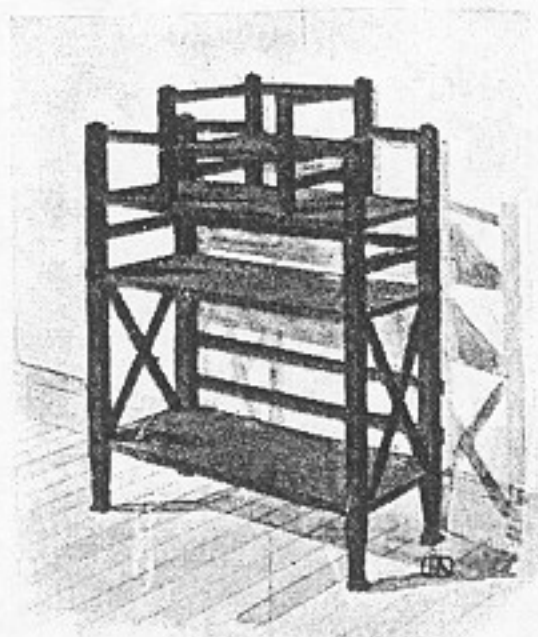


Fig. 11

magazines.

The wood-work should be stained and varnished, or painted to match the trim of the room.

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A Book-chair

A novel idea is shown in the illustration of a book-chair (Fig. 12). A Morris chair may be made over on this plan, if the side spindles are removed and the receptacle is constructed beneath the seat. A very low Morris chair cannot be used, however, since the available space between the seat-rail and the floor is too cramped. Both sides of the chair are arranged to receive books, and at the front a wooden panel is fitted below the seat-rail, as shown in Fig. 13.

Cushions of burlap, tapestry cloth, or canterbury cloth may be made to fit the seat and back; they are held on with straps. The cushions may be filled with feathers, curled hair, cocoa fibre, moss or even cotton batting. Javanese *kapok* is perhaps the best of the lower grade material. It costs twenty-five cents a pound, and takes about two and a half pounds for a chair.

The ornament at the front of the chair is painted on and outlined with the pyrographic point; or a dark-brown line may be painted on with a fine brush.

A Book-table

For a library or sitting-room, the book-table shown in Fig. 14 will be found a convenient and useful piece of furniture.

A good size for this table is: length, forty-two inches; width, twenty-four inches; and height, thirty inches. The drop-shelves at the ends should be nine inches below the

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top of the table, while the drawer need not be more than four inches deep. The legs are two and a half inches or three inches square. The slats at the sides of the book-shelves are let into the table-top and the shelf (see Fig. 15) and apparently anchored by means of large nail-heads. The top is attached to the frame by means of cleats screwed



Fig. 12

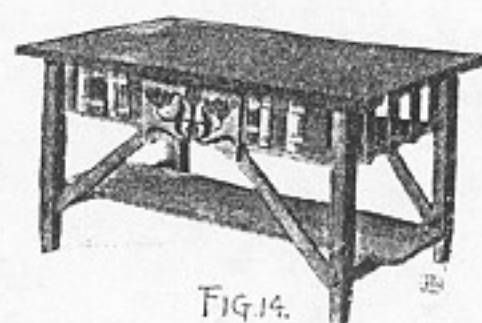


Fig. 14.

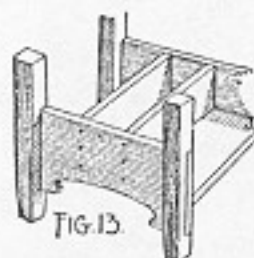


Fig. 13.

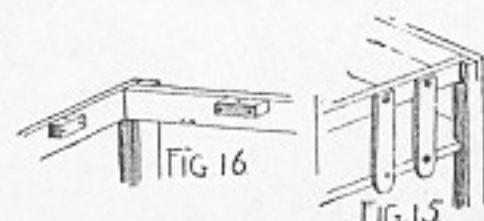


Fig. 16

Fig. 15

fast to the top inner edges of the rails. Through these cleats screws are passed up and into the under side of the table-top, as shown in Fig. 16.

White-wood is a good material of which to make the table, since it takes a stain nicely. Finish with a coat or two of shellac.

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A Magazine-rack

A convenient rack for magazines and periodicals is shown in Fig. 17.

The rack has three shelves and an enclosure at the top to hold extra large pamphlets. The two uprights and the cross-strip at the top are three-quarters of an inch thick and two and a half inches wide. The uprights are twenty-four inches long, and the cross-piece measures eighteen inches from tip to tip. Four inches from the top the uprights are cut, as shown in Fig. 18 A, so that a lap-joint can be formed. The uprights are spaced ten inches apart from the inside edges, making the total width fifteen inches.

From half-inch wood cut three shelves fifteen inches long

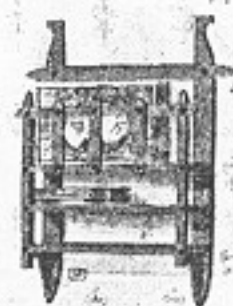


Fig. 17



Fig. 18

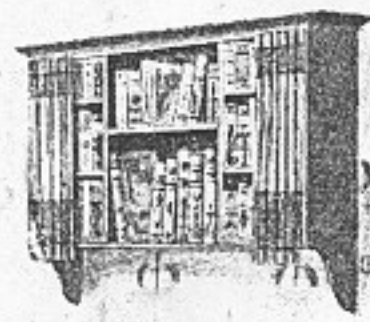


Fig. 19

and six inches wide; also two corner-posts from wood an inch square. Cut the end of each shelf as shown in Fig. 18 B, so that one notch will fit against the upright and the

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other against the corner-post. From the half-inch wood cut two brackets three inches long and two and a half inches wide at the top, as shown at Fig. 18 C. These hold up

the bottom shelf, and the other shelves are supported in turn by the corner-posts and the back, to which the shelves are securely attached with screws and glue. The corner-posts are fifteen inches high, and near the top laps are cut half an inch deep and one inch wide into which a cross-rail will fit. Three thin slats one inch in width and six inches long are made fast across the front, and above the top shelf, to form the pamphlet or periodical rack. The nail and screw heads may be covered with brass upholsterers' tacks painted black to suggest the idea of a large nail, or imitation wrought-iron nail-heads may be made by cutting disks out of sheet-lead and slightly beating the edges so as to imitate the hammer-marks of wrought-iron work. These disks are secured to the wood with slim steel nails, the heads of which, when driven in with a light hammer, become imbedded in the soft lead. A subsequent coating of black paint will conceal the nail-heads completely.

A Box Book-case

Fig. 19 is an idea for a receptacle for a few books, bric-à-brac, and some magazines to hang against the wall. Boxes of various sizes may be used for this purpose, according to the available wall space, but for general use two shoe-cases should be cut down so as to make them thirty inches high and seven inches deep. In each one two shelves can be arranged.

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The boxes are held together at top and bottom with boards seven inches wide and thirty-six inches long. Between the boxes a shelf may be fastened about midway between the top and bottom boards. A wooden back is not necessary to this case, as the wall itself will answer the purpose; but around the top edge a strip of cornice-moulding is to be mitred at the corners and attached with long, slim nails or screws. Under the lower corners wooden brackets may be fastened to the wall, or when the shoe-cases are being cut down one side may be trimmed, with the compass-saw, in the form of a bracket end. A rod fastened at the top and under the moulding will support light curtains, but this last feature may be omitted at pleasure.

A Nursery Book-rack

A nursery is not quite complete without some receptacle for the accommodation of the children's scrap and picture books. A simple and useful design is shown in Fig. 20.

A well-made box of thin boards, planed on both sides, forms the basis for this bookcase. It should be of medium size and not more than seven inches deep. Remove one side or the top, so as to leave it open at the front, and arrange a shelf in the open space. The box should be at least sixteen inches high to accommodate two rows of books, and it would be better to have it eighteen inches. Two brackets eight inches high and six inches wide at the top are placed under each end of the box. Across the top, at the back, a wall-plate is cut and attached with two slim

screws that pass down through the narrow part near the

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ends and into the back of the box at the top. Around the top of the box a narrow strip of moulding should be mitred and fastened with steel-wire nails. The wood-work may then be given a coat of stain and shellac. Across the front

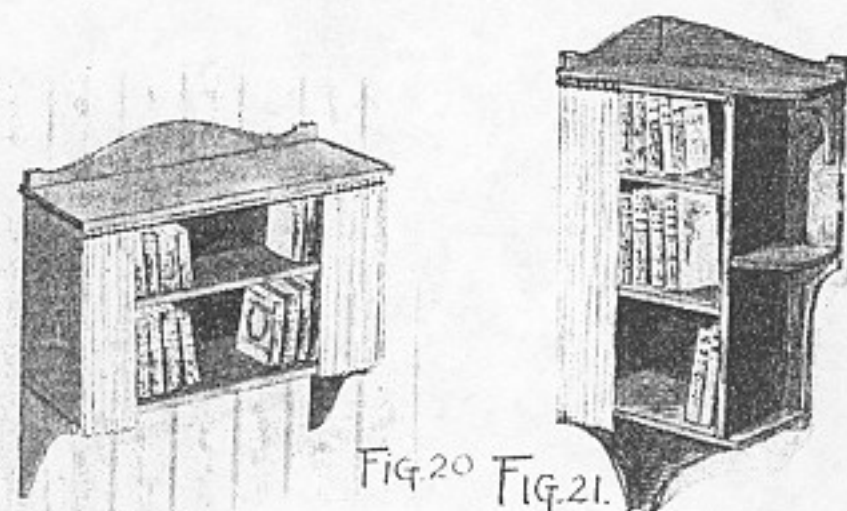


FIG. 20 FIG. 21.

of the box and at the top a brass or iron rod may be attached at the ends, from which curtains are suspended by means of rings.

When fastening this case to the wall, it would be well to drive two or three screws through the back of the box and into the wall-studding, otherwise the weight of books might tear it away from its bracket anchorage.

Another Book-rack

In Fig. 21 an odd shape for a book-rack is shown.

This is also made from a box by removing one side and resetting it closer to the other side. A portion of the

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lower end is sawed off, and a part of the bottom is cut away so as to form a small, quarter-circular bracket. The extending upper end of the box is supported with a short bracket, as the illustration clearly shows, and under the box two large brackets ten inches deep and the width of the back and side support the rack in position. Two wall-plates four inches high at the angle are attached at the top of the box with screws. A curtain-rod is attached at the top of the case from which a curtain may be hung, and the ledge formed by the top of the case and the quarter-circular bracket will accommodate a few pieces of bric-à-brac or a photograph frame or two. If the box is high enough, two shelves may be arranged so that three lines of books can be accommodated; otherwise one shelf will have to suffice.

A Handy Piece of Furniture

A place to put books and a place to keep bats, golf-clubs, lacrosse-sticks, and other things that are always around, is a convenient possession.

Here is a solution of the problem: The case shown in Fig. 22 should be about five feet six inches high and three feet wide. The shelf across the top would hold a number of books, and underneath are two beautiful tuck-away

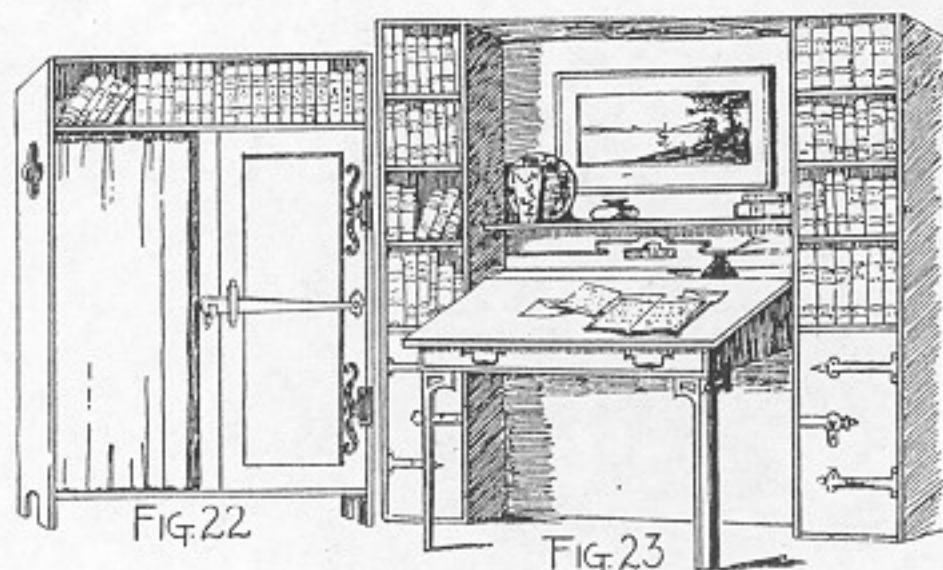
places. If, my friend, you are a college boy, the curtain could be of your college colors; the rest of the case stained a becoming color. The door is fastened by a big wooden latch, and a pair of iron hinges would add very much to the style of the bookcase.

If, however, you are of a studious frame of mind, and

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have been fortunate enough to collect a number of books, the second case would probably be more to your liking.

We will suppose that you have already a desk. Make two upright rows of bookshelves far enough apart to allow the desk to be placed between them. Shut off the lower part of the shelves, on each side, with a door, which may be decorated with iron hinges or blackened metal. These false hinges are of course placed against the real



ones on which the door swings, and are purely ornamental. These little closets make fine places in which to store unsightly books and magazines which look untidy but which one always wants to keep. There is a shelf over the top of the desk on which could be placed a row of plates, a tankard, or photographs; and a poster or nice little etching would give interest to the big panel. This panel, by-the-

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way, need not be made of wood, but could be closed in by a piece of colored burlap or buckram. The case would then have to be braced by three slats of wood nailed across the back behind the buckram. When completed it will appear as shown in Fig. 23.

A Book-ledge and Stool

Two interesting and useful pieces of furniture are shown in the drawing of a book-ledge and stool (Fig. 24), and as the main shelf is but fourteen inches wide it will not occupy a great deal of space in a room.

The main shelf is forty-two inches long, fourteen wide, and one inch and a quarter thick. The side pieces, or legs, supporting it are twelve inches wide and thirty-three inches high, with V-shaped pieces cut from the foot of each one. These pieces are thirty-six inches apart, and arranged between them, and twenty inches above the floor an under ledge eight inches wide is fastened with long screws and

brackets. Nine inches above the main ledge a top shelf is supported on side legs, which, in turn, are propped at the outside with wood braces, or blocks, six inches high and four inches wide at the bottom. The side supports are placed the same distance apart as the under-side pieces, and are held in position on the top of the main ledge with short dowels, or pegs, driven in their under end, and which fit into holes bored in a corresponding position in the ledge. This upper section may be omitted, however, if the plain ledge is preferred.

The stool is twelve inches square and twenty-two inches

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high. The top is covered with a stout square of leather caught all around the edges with nails and imitation nail-heads. The lower rails that bind the posts together are one and three-quarter inches wide and seven-eighths of an



inch thick. The posts are one and three-quarter inches square, and the rails are let into them three inches up from the floor. The top rails are the same width, and all let into the top of the posts with the lap-joint union, where they are glued and screwed fast. Small brackets under these rails will add an element of support, and they can be dressed out of seven-eighths-inch wood with a compass-saw, and made fast with glue and screws. These brackets are comparatively small, being two and a half inches wide and four inches deep, but they must be cut accurately to fit well.

Chapter XXI

CLOCKS AND TIMEPIECES

AMONG the many useful and attractive pieces of furniture that a boy can make to help furnish a home, clocks and timepieces offer a good field for endeavor. Now, a clock is more often looked at than any other piece of furniture; consequently, it should be a thing of beauty rather than a distracting eyesore. And, since it is no more expensive to construct a clock on good lines than on poor ones, there is no reasonable excuse for the inartistic, commonplace designs that are displayed for sale by jewelers, department stores, and house-furnishing shops.

Several good designs for simple and artistic cases are

shown on the following pages, and none of them are too intricate to be made at home by the boy who has gained some knowledge in the handling of tools. There is nothing in their construction that requires the services of a cabinet-maker, and the movements may be had from a clock-manufacturer, or perhaps taken out of an old or unsightly case. For instruction in the use of the pyrographic-point, see Chapter XII.

Thin white-wood or pine boards, sheet-lead, stain, and shellac are some of the simple materials needed; and the

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tools required will be those that may be found in every household, such as a saw, hammer, plane, awl, square, mallet, compass-saw, and brace and bit. Some steel-wire nails, glue, sand-paper, and black paint will complete the list of necessities, and the various small accessories may be had at a hardware store at a nominal outlay.

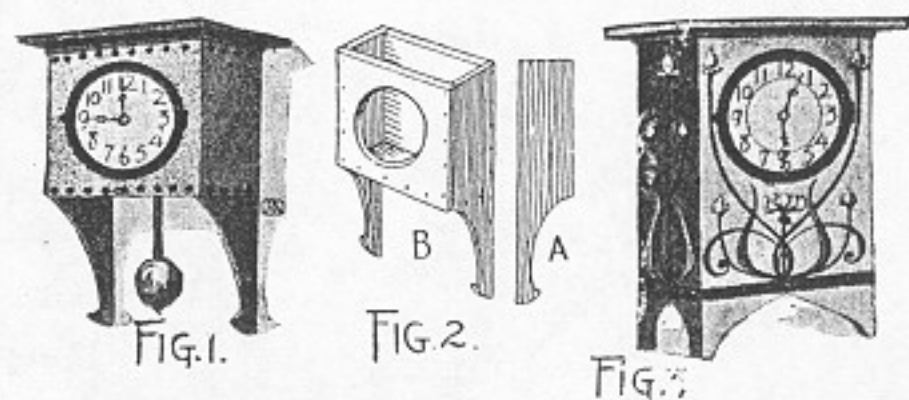
A Bracket-clock

A design for a simple bracket-clock is shown in Fig. 1, and the case is so plain in construction that any smart boy can easily make it from thin pieces of board half an inch in thickness, half a yard of burlap, and some sheet-lead.

The box part of the clock is eight inches square and three and a half inches deep. The brackets are extensions of the sides, cut as shown in Fig. 2 A; they drop eight inches below the bottom-board of the case. The dial and glass frame measure six inches in diameter, and to fit them to the box it will be necessary to cut a hole in the front of the case five and a half inches in diameter, as shown in Fig. 2 B. The shelf-top to the box is bevelled at the under side, and is attached by means of glue and nails; it overhangs one and a half inches at the front and ends. The sides and front of the box are then covered with tinted burlap in a soft, old-green, red, or tan shade, and the exposed wood-work is stained a color to match. When dry it is given a coat or two of thin shellac to lend a lustre to the grain and stain.

To hide the joint between the cap and the body of the clock, a round piece of wood, such as a dowel, should be

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inserted and nailed fast; or a narrow strip of picture-moulding can be used.

If it is impossible to find the large nails that bind the corners at a hardware store, they may be made from sheet-lead. Disks half an inch in diameter are cut from the lead

by means of a small cold-chisel and mallet. The edges of the disks are beaten with a tack-hammer to give them the appearance of a rough, hammer-headed nail. These disks are painted with a dead-black paint, made by adding a small portion of dry lamp-black to thin shellac, and applying it to the metal-work with a soft brush. These heads are attached to the clock, as shown in the illustration, at regular distances apart, with thin, small-headed, steel-wire nails, which when driven in and painted with the black preparation become invisible.

The movement, which may be of either the spring or weight kind, is attached to the back of the case before the dial is made fast, and the pendulum-rod is dropped through a slot cut in the bottom-board.

If the mounting is bothersome, however, a clock-maker

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will arrange it and adjust the dial and space the hands properly.

A metal hanger at the top and two long, slim screws driven through the bottom of each bracket will hold this clock in place against the wall.

A Mantel-clock

A simple but artistic mantel-clock is shown in Fig. 3. It is seven inches wide, thirteen inches high, and three and a half inches deep. It is made from thin white-wood, pine, cypress, or almost any soft wood.

The top, or cap, is of half-inch wood, and it projects one and a half inches beyond the front and sides. A small moulding, or a dowel, is cut and mitred around the top under the cap. At the bottom the feet are made by cutting out pieces of the wood with a compass-saw. A small pendulum movement is mounted against the back before the dial and glass frame are set in place.

The ornament on the front and sides is outlined with pencil, and after the wood-work is stained a soft-brown, an old-green, or any desired shade, the lines of the ornament are pyrographically burned. Or they may be painted with a dark-brown paint in imitation of pyrography. Below the ornament a half-inch band of sheet-lead is laid around the body of the clock and held on with large, oval-headed upholsterers' nails painted black.

A Wall-clock

An attractive wall-clock is shown in Fig. 4, page 327. With a movement having a fifteen-inch pendulum, the case

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should be ten inches wide, twenty-four inches high, and four inches deep. A circular opening is made at the upper end of the box, and an oblong one at the lower end through which the pendulum may be seen. The box is covered with burlap in some desirable shade; it is applied with glue and large-headed nails, or dummy heads.

The ornamental design is cut from sheet-lead and applied with slim, steel-wire nails. The frame around the lower opening is cut from lead and applied over a piece of glass which is cut and fitted to the opening. The stems to

the buds are made of thin telegraph wire, bent to the proper shape, and applied with small staples made from pins.

The top is cut from white-wood five-eighths of an inch thick; it overhangs the sides and front two inches. Where the top is applied to the body of the clock, the joint is hidden with a small strip of moulding, or a dowel mitred at the corners, and attached with slim, steel-wire nails.

The large nail-heads all along the edges are made from sheet-lead beaten to represent wrought-iron bellows-nails, and fastened on with thin, steel nails, and afterwards painted black.

The bottom of the box should be arranged on hinges, and caught with a small bolt so that it may be dropped in order to start the pendulum, and also to adjust the screw at the bottom of the rod.

A pleasing combination of colors for this case will be light, olive-green burlap, black metal-work, and old-brown wood-work. The pendulum-ball may be of bright brass or blackened. Equally effective are combinations of red burlap and brass trimmings, or old-gold-colored burlap and

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Pompeian-green metal-work, made by tinting all the metal parts with a light and dark olive-green paint blended together on the parts.

A High Wall-clock

For the space over a mantel, or wherever it may be convenient to hang it, a substantial high wall-clock is shown in Fig. 5. It is ten inches wide, thirty inches high at the front, and four inches deep, with the bracket-ends and the fancy top-pieces extending five or six inches beyond the body of the clock at top and bottom.

In construction it is somewhat on the lines of the "mission" furniture, the pieces being tongued and pinned, with a heavy slatted front.

The wood-work is five-eighths of an inch in thickness. The cross-rails are two inches in width, and the upright ones and the lattice are one and a quarter inches in width. The ends of the cross-pieces are shaped as shown in Fig. 6. When passed through mortises cut in front of the side boards they are held in place with wooden pins.

At the back, near the top and bottom, two-inch cross-strips are let into the side boards. The ends should project two inches beyond the boards at both sides, and holes are made in them through which screws are passed to anchor the clock to the wall.

An eight-day movement, with a twelve-inch pendulum, is made fast to a back-board, and on the front-board, to cover a hole eight inches in diameter, a large dial and glass are fastened.

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The ornament at the sides and on the front-board around the dial is cut with a carving-chisel, and tinted to darken the lines. Stain and varnish will be a desirable finish; or the stain alone may be used should an old, dull appearance be desired.

Fig. 7.

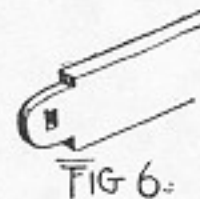
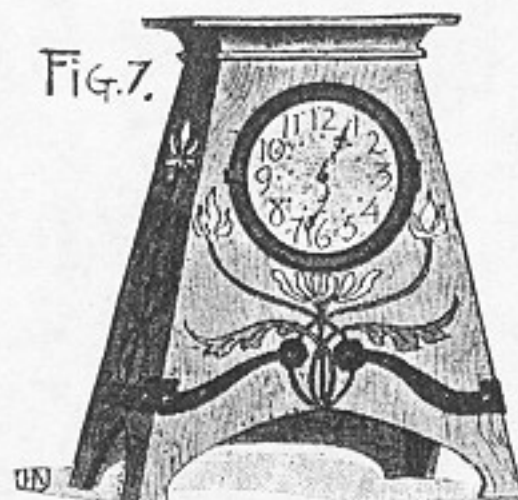


FIG 6.



Fig. 4.

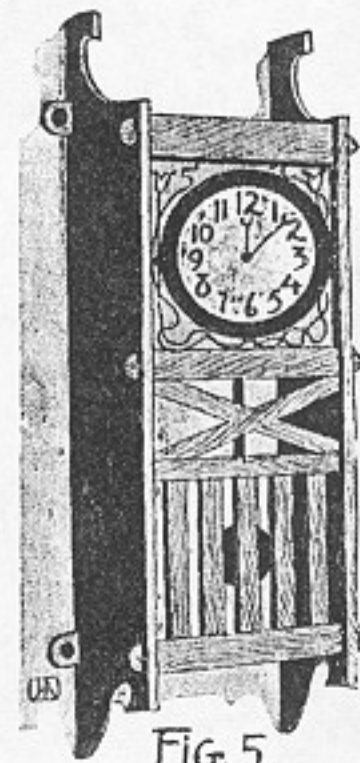


Fig. 5.

HANGING AND MANTEL CLOCKS

An Odd Mantel-clock

The design for a mantel-clock that is odd in shape and striking in appearance is shown in Fig. 7. It is seven inches wide at the top, underneath the cap, and ten inches across at the base. In width it varies from three inches at the top to four and a half inches at the base.

The case is made from three-eighths-inch white-wood and joined with glue and nails. The top is of core-moulding that may be had at a carpenter-shop or planing-mill. It is mitred to fit at the front and ends.

The metal straps are of lead and the ornament is tinted and outlined. A great deal of the beauty of this design is in its coloring, and, unfortunately, this cannot be reproduced. The wood-work is in light golden-brown, the buds in orange, toning down to a deep red at the base, or similar to the colorings of the California poppy. The stems and leaves are in several shades of green, and the entire ornament is lined by the pyrographic-point, or painted with a line in dark brown. The straps, nails, and glass frame are in dead black, and the cap-moulding is in a darker shade of brown than that employed for the body color of the case. A pale, old-pink dial, on which black numerals are painted, completes this harmonious color-scheme.

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A Shelf-clock

A quaint clock is shown in Fig. 8, and it is quite as sim-

ple to construct as it is in appearance.

It is fourteen inches wide, twelve inches high, and four and a half inches in depth. A six-inch dial and glass are mounted on the front, and in the bottom of the movement-box a narrow slot is cut to accommodate the swing of the pendulum-rod.

White-wood boards three-eighths of an inch in thickness

that are so handy and generally useful as screens, shoe-boxes, and settles of various kinds.

Screens in particular are of so many and varied designs that it would be quite impossible in this short chapter to give more than a few of the simpler forms; but they will serve as hints for others.

A Light-screen

One of the easiest screens to make, and perhaps the most generally useful, is that shown in Fig. 1. This is a light-screen, which may be easily taken from one room to another.

Four rails of pine or white-wood are cut and tapered at one end for the tops, and slightly cut away at the other for the bottom, as shown in the illustration. The rails are four feet six inches long, two and a half inches in width, and seven-eighths of an inch thick. Dowels five-eighths of an inch in diameter are used for the cross-sticks. They can be purchased at a hardware store or from a cabinet-maker, and should be cut twenty-four inches long. Holes

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are to be bored in one edge of each strip, into which the dowels are driven, and fastened with glue and small nails. Four or five dowels will be sufficient for each wing, and they should be spaced evenly, the first one four inches below the top of the rails and the bottom one ten inches above the floor.

The wings are fastened together with two or three hinges, so that the screen may be folded and stood in a closet or behind a door when not in use.

Some pretty figured material, such as China silk, silkoline, cretonne, or printed cotton goods may be used for the covering, which is to show on both sides of each wing. It should be from three to five feet wide, so as to allow for some fulness. One end of the goods is tacked to the top dowel; then it is passed around the bottom dowel and brought up to the top, where it is again tacked fast. Some narrow gimp and brass nails will hide the edges of the goods at the top, and to hold the material in place a few tacks may be driven along the bottom dowel.

The wood-work should be painted, or stained and varnished, before the covering material is put on. If a dull finish is desired, some dark paint may be thinned with turpentine and rubbed on with a soft cloth, then partially wiped off and allowed to dry. It will not be necessary to varnish or shellac the surface, but a little beeswax can be dissolved in turpentine and rubbed on.

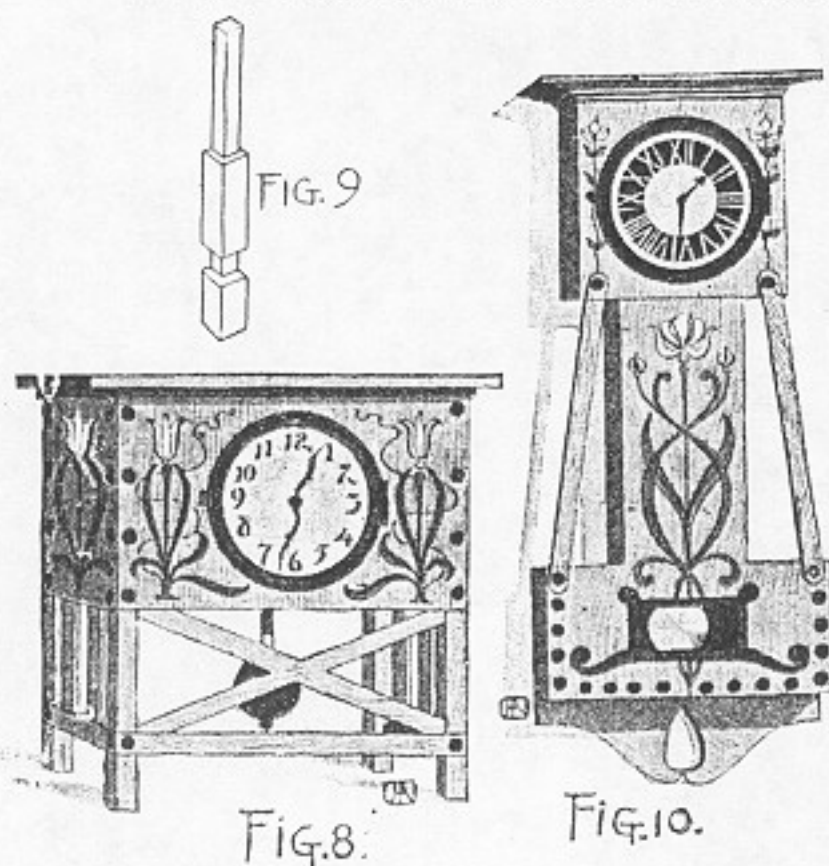
A Fire-screen

When an open fire is burning on the hearth a screen that will protect the eyes from the glare, and yet allow the heat

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to reach the lower part of the body and the feet, is a useful piece of furniture.

A simple screen of this description is shown in Fig. 2, and for a living-room or bedroom it should measure thirty-



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are fastened to corner-posts, having the two upper sides cut away as shown in Fig. 9. Laps are cut at the lower end of each corner-post into which the rail fits, as also shown in Fig. 9.

The same general description given for the other cases applies to this one, and after the ornament is stained and lined the surface of the wood may be lightly lined from top to bottom with the pyrographic-point.

An Old-style Timepiece

A case of old-fashioned design is shown in Fig. 10.

The top measures eight inches square; the waist is five inches wide and twelve inches long; and the base is six inches high and twelve inches long. Two bars are fastened from the top to the base; they pitch at a slight angle.

The average depth is four inches, and the top, or head, extends out over the waist for a quarter of an inch, or enough to make a break in the straight line of the front.

The ornamentation is carried out as described for the other designs, and if properly constructed this clock should present a very unique appearance.

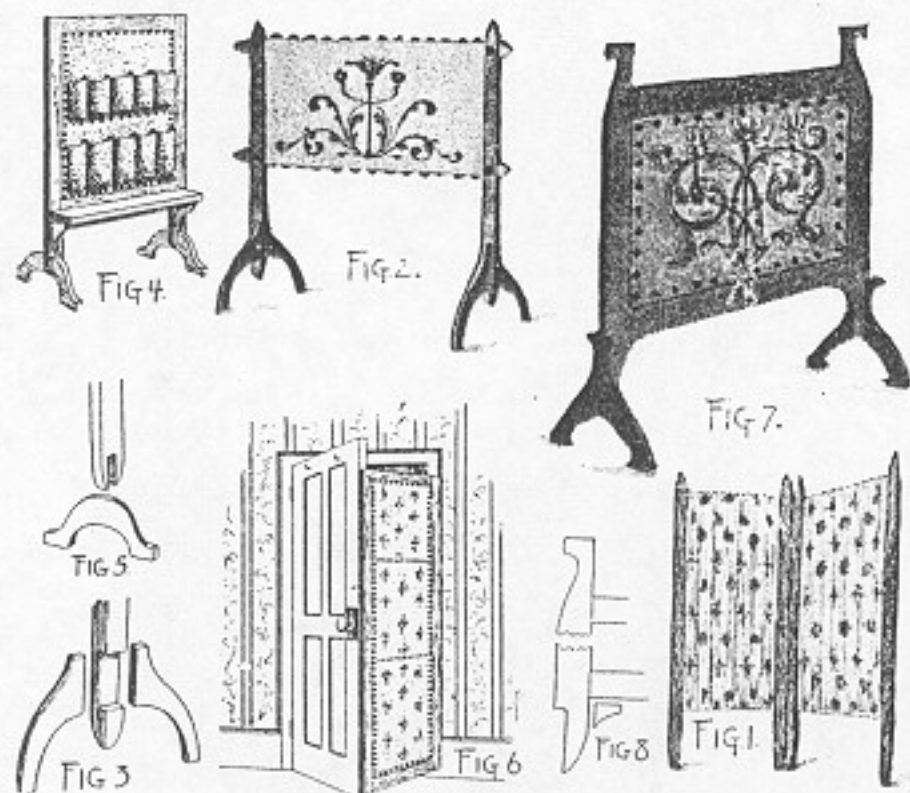
Chapter XXII

SCREENS, SHOE-BOXES, AND WINDOW-SEATS

AMONG the many convenient pieces of furniture that a boy can make for the home, there are, perhaps, none

six inches long, forty-two inches high, the screen proper being eighteen or twenty inches wide.

The uprights are of wood two inches square, and the cross-rails are seven-eighths of an inch thick and two



inches wide. The joints are mortised and tenoned, and held with screws and glue, while the apparent fastenings are large, round, mock nail-heads. The feet are cut from

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hard-wood seven-eighths of an inch in thickness, as shown in Fig. 3, and attached to the bottom of the upright posts with glue and screws, the vertical edges of the feet being let into a lap cut in the posts. Each foot will then measure eighteen inches across at the bottom, and twelve inches high from the floor to the top of the lap cut in the posts.

Leather, burlap, denim, tapestry-cloth, or any good covering fabric, may be used for the screen. This material should be tacked on the top and bottom rail with large upholsterers' tacks painted black.

A design may be lightly drawn on the fabric with a pencil, and afterwards painted in oil or water colors, or the ornament may be stencilled on with aniline colors, as described in Chapter XIX.

A Shoe-screen

For a bedroom a convenient screen is shown in Fig. 4. This is properly called a shoe-screen, since there is a ledge made fast to the lower part of it to serve as a rest for the foot when lacing or buttoning shoes. There are also two rows of pockets on the inside of the screen, into which shoes, slippers, and sandals can be slipped.

A convenient size to make this screen is three feet six inches high and two feet six inches wide. The foot-ledge should not be more than fourteen inches above the floor and six inches wide. The frame may be made from any easily worked wood, since when it is painted, or stained and varnished, nothing but the grain will show. The uprights should be three inches wide, seven-eighths of an inch thick, and three feet three inches long. Lap or

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dowelled joints should be made at the top corners, and at the foot of both pieces notches are to be cut in with saw and chisel, as shown at Fig. 5. The foot-pieces may then be driven up in place and made fast with screws or slim nails driven through the projecting ends of the side uprights and into the feet. The feet are of wood seven-eighths of an inch thick, sixteen inches long, and six inches high. The pattern may be drawn with lead-pencil on the wood; then, with a compass-saw, cut the wood on the lines, having first clamped the piece in a vise to hold it securely. The foot-shelf is made fast to the screen after the covering material is in place, and at both ends it is supported with brackets, the lower ends of which are made fast with screws.

A cross-rib should be made fast in the screen-frame midway between the top-rail and the one to which the ledge is attached, and a line of tacks is driven through the covering material and into the frame on both sides. This is to give a better finish, and also to support the rows of pockets when full of shoes.

The strip of denim for the pockets is seven inches wide and hemmed on both edges. It is then caught to the covering material so that generous pockets will be formed, each one being large enough to accommodate a pair of shoes.

The front of the screen may be covered with a fancy-figured material fastened on with small tacks; over this a gimp to match the material can be laid and held down with large-headed tacks, such as may be purchased at upholstery supply stores. The painting, staining, or varnishing should, of course, be done before the fabric, or covering material, is made fast to the frame.

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A Bedroom-door Screen

At night it is often agreeable to have a bedroom door left open. Yet one does not want to sleep in an actual draught, and a screen such as is shown in Fig. 6 will be found most useful.

This screen is in one piece, six feet six inches high and eighteen inches wide. The frame is made from pine, white-wood, or any other wood to match the trim of the room. Two cross-rails are fixed so as to remain equal distances apart, thus forming three panels to the screen. Hinges are arranged at one edge, which in turn are made fast to the door-casing, so that when the screen is not in use it can be thrown back against the wall; or, if thought preferable, eyes may be driven in the casing and hooks in the edge of the screen, so that it may swing as if on hinges, and yet be lifted off at will and set away in a closet. An eye on the door and a hook on the screen will serve as a fairly secure fastening against intrusion. Any pretty material that matches the paper of the room may be used to cover this screen, and the edges should be bound with gimp and large-headed tacks to give it a good appearance.

A Heavy Fire-screen

For a dining-room, living-room, or library, an attractive

design for a heavy fire-screen is shown in Fig. 7. This is constructed of oak, ash, or other hard-wood. It is thirty-six inches wide, forty-two inches high, and the rails and feet are one and one-eighth inches thick. The uprights and

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cross-rails are four inches wide, and the top and bottom of each upright are cut as shown in Fig. 8.

The cross-rails should be mortised in the uprights, or they may be made fast by butting one end against an edge and securing the joint with dowels. The feet are fourteen inches across at the bottom and fifteen inches high. They are glued and screwed in the laps cut at the lower ends of the uprights, and the screw-heads are covered with imitation wrought-iron nail-heads beaten from sheet-lead and attached with steel-wire nails, the heads of which are invisible when driven into the lead.

The side of the screen which faces the fire should be covered with burlap, denim, or other stout cotton fabric. The outer side of the screen should be faced with leather, on which the ornamental design is followed out with stains and pyrography (see Chapter XII).

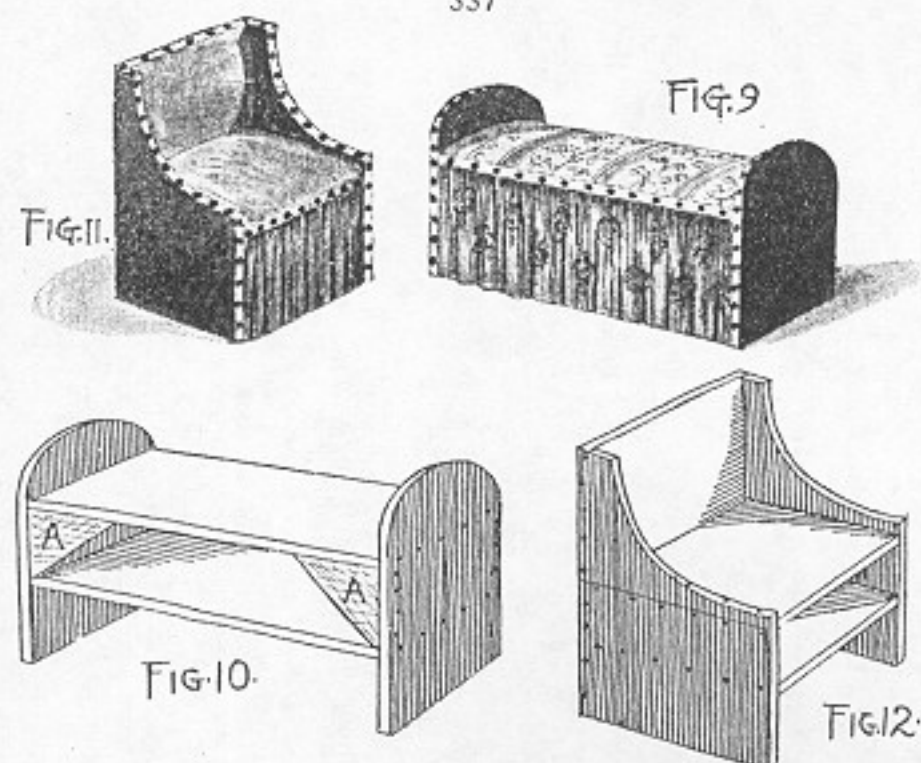
The leather should be caught to the frame with tacks placed two inches apart, and also glue. Over the tacks imitation lead heads may be secured with slim, steel nails.

A Window-seat with Under Ledge

In the drawing of the window-seat with under ledge (Fig. 9) an odd but useful piece of furniture is shown. It is made from two boards fourteen inches wide and forty inches long, two end-pieces fifteen inches wide and twenty-two inches high, and four brackets eight inches on the right-angle edges. These latter are necessary to brace the top and ends, as shown in Fig. 10 A A.

The top shelf, or seat, is eighteen inches high from the

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floor, and the under ledge is made fast eight inches below it. The fastening is made with screws and liquid glue, and allowed to stand several hours before the drapery is

attached.

For the upholstery material the dry-goods stores offer quite a variety of stuffs from which to choose. The least expensive are burlap, denim, cretonne, and some of the heavy, cotton, printed goods. Other fabrics, richer in appearance and more lasting, are velour, tapestry-cloth, rep, and brocade. Goods of this class will cost from fifty cents to several dollars a yard.

To upholster this seat, obtain some curled hair from an

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old mattress, and spread it over the top board, having first tacked a piece of unbleached muslin along one edge of the seat. When a sufficient quantity of the hair is on the board, draw the muslin over it, and tack it down along the other edge and at the ends. Over this the fabric can be drawn and tacked.

The end boards are covered with plain goods of the same color as the seat and flounce, and the edges are bound with gimp an inch wide, held down with large, oval-headed upholsterers' tacks painted black. Across the back of the seat (the part that goes against the wall or window-base) plain goods can be drawn and tacked, or it may be left open.

The front is provided with a flounce made by shirring the goods on a stout cotton cord and tacking it along the front of the top board, then covering the tacks with gimp and nails, as shown in the drawing. A coat of paint or shellac at the inside will finish the wood-work, and it will then be ready for use.

A Shoe-box Seat

A shoe-box seat is easily made and upholstered, and will be an acceptable addition in any bedroom (see Fig. 11). The sides are eighteen inches wide, thirty-six inches high at the back, and twenty-two inches at the front. The seat and ledge under it are each eighteen inches square, and the boards forming the back extend down to the floor. The parts are put together with screws and glue; then the seat is upholstered with curled hair, as described for the window-seat (Fig. 9).

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The framework for this seat could be made from a box with the bottom and one side removed. The arms should be cut from a separate piece of wood and screwed fast, as shown in Fig. 12 by the line along the shaded side.

Plain or figured goods may be used for the covering material. It is drawn and caught with tacks at the edges; then the joints may be hidden with gimp and large-headed tacks. If it is possible to procure some English bellows-nails they will add an artistic effect to the trimming. If they cannot be had, very good imitation heads may be cut from sheet-lead with a pair of old scissors or shears. After beating them about the edge to flatten them and lend a hand-forged effect, these disks should be attached to the wood with long, slim finishing-nails of steel wire, which, when driven into the heads, become imbedded in the lead

and are not seen. They should be painted black with a solution of shellac in which some dry lamp-black has been mixed to the consistency of cream. Apply with a soft brush.

A Dressing-room Settle

In the illustration for a dressing-room settle (Fig. 13) a comfortable piece of furniture is illustrated, and in Fig. 14 its construction is clearly indicated.

The ends are three feet high and sixteen inches wide. The back-boards extend from the top of the ends down to the floor, and are attached with screws. The seat and under ledge should be from thirty to forty-eight inches long, according to the space it will occupy against the wall or under a window.

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The upholstering is done as described for the other pieces of furniture, save that a more elaborate ornamentation is suggested for the end-pieces. The design is drawn in free-hand, and then embroidered on with heavy linen thread. Mother or elder sister will have to help out with the needle-work.

A Short Settle

A short settle with under ledge (Fig. 15) is another comfortable piece of bedroom or sitting-room furniture. In

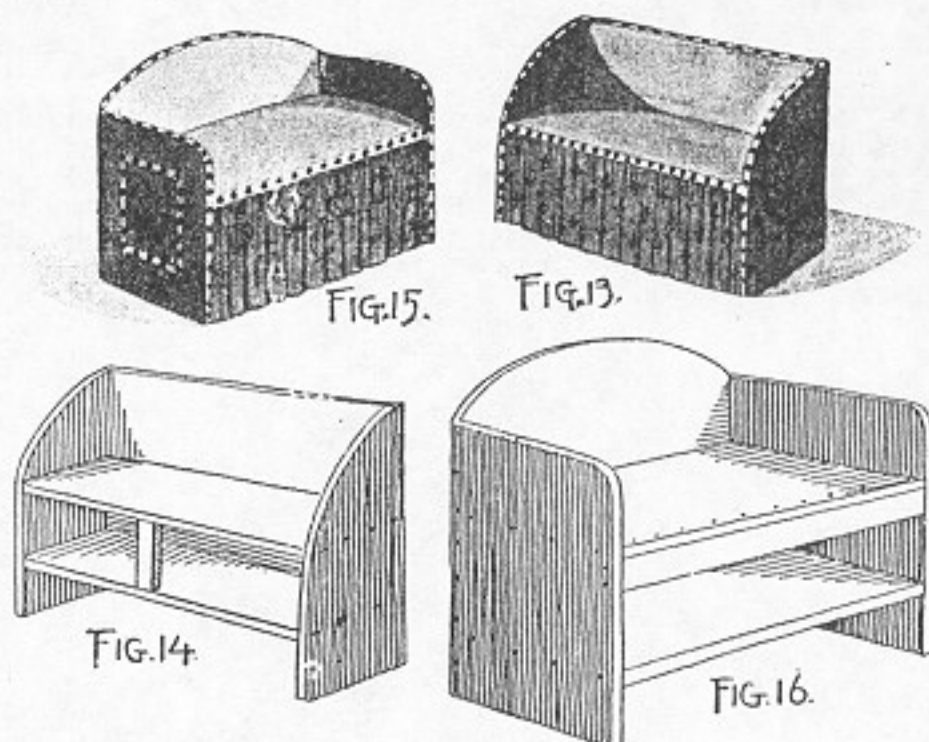


Fig. 16 the constructional diagram is shown for the arrangement of its sides, back, and under ledge.

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The ends are sixteen inches wide and twenty-three inches high. The back extends down to the floor, and above the ends it curves or rounds over, extending up about five inches higher than the tops of the ends. Under the seat a strip of wood two and a half inches in width is attached at both ends, and the front edge of the seat is screwed fast to it. This acts as a support, and obviates the necessity of a brace block.

A Foot-rest

When putting on shoes it is convenient to have a short bench on which to rest the foot, and while a hassock will answer well enough, it is not so good as a bench or so easily handled.

Fig. 17 shows a neat foot-bench that is easy to construct from four pieces of wood. In Fig. 18 page 345 the plain bench is shown, while at B a view of the inverted bench is given so that the cross-bar may be seen.

The top board is eighteen inches long, ten inches wide, and an inch thick. The ends, or legs, are seven inches high and eight inches wide, with a V notch cut in from the bottom of each. These feet are set fourteen inches apart, so that there will be two inches of overhang at each end of the bench; that is, the top will extend two inches over the legs at each end. The brace shown at Fig. 18 B is two inches wide, twelve and a half inches long, and an inch in thickness.

The four parts are put together with glue and screws; then the top is padded with curled hair and upholstered as already described.

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A Combination Shoe-box and Seat

From two canned-goods boxes the combination shoe-box and seat may be made, as shown in Fig. 19, Fig. 20 being the structural plan.

The left-hand box in Fig. 20 has the lid removed, and a shelf is inserted so as to divide it into two compartments. The other box is provided with a hinged lid. Instead of making the hinges fast to the edge of the box, a strip an inch or two wide should be attached to the rear of the box, and to this the lid is hinged, as shown in Fig. 20. The two boxes are screwed together, and a back is provided for the one on the right. The board forming this back should extend the entire length of the two boxes, and should be secured to them with stout screws. The tops of the boxes are padded with hair, and the sides are covered with upholstery material of any desirable color and quality, the edges being bound with gimp and nails.

The inside of the low box and the under side of the lid should be provided with denim pockets, as shown at Fig. 21. These pockets are formed by tacking a strip of denim to the wood and allowing fulness enough to accommodate a pair of shoes or slippers.

It furnishes the inside of such boxes nicely to line them with unbleached muslin tacked at the corners and edges. Where wood is exposed in the ledge and shelf seats a coat of paint or shellac is desirable.

A Double Shoe-box and Seat

Three well-made boxes, two of a size and one longer, will make the foundation for a double shoe-box and seat, such as is shown in Fig. 22.

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In Fig. 23 the structural arrangement is indicated. The end boxes are provided with two shelves each, and the middle one is fitted with a back-board, which is rounded

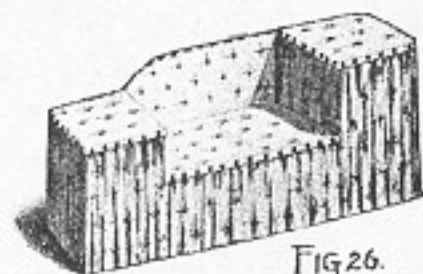


FIG. 26.

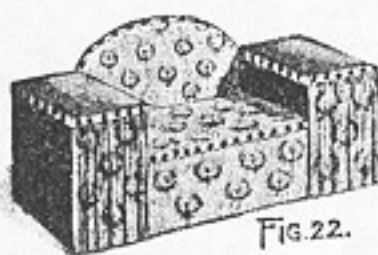


FIG. 22.

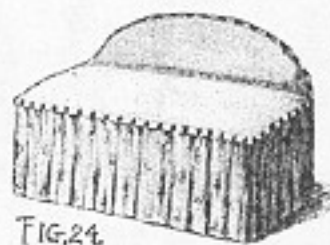


FIG. 24.



FIG. 17.



FIG. 19.

over at the top and projects about six inches above the top of the end boxes.

The middle box is provided with a lid and hinges which are made fast to a back strip, so that when the lid is raised it will not fall again, but will stand out an inch or two from the back-boards.

A Curved-back Window-seat

Fig. 24 illustrates a useful piece of furniture. The box part, or frame, is thirty-eight inches long, sixteen inches wide, and fifteen inches high, and the top of the back is

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fourteen inches above the seat. The structural plan is shown in Fig. 25.

Four inches from the bottom a ledge is arranged, and at the middle a division-brace is placed. The unions may be made with nails, but screws are preferable.

The back is made from two boards shaped into a curve with a draw-knife and plane and held together with battens, as shown by the dotted lines in Fig. 25. The battens extend down behind the back of the box, and the ends are made fast with screws to support the back. The back and seat are padded with curled hair and covered with unbleached muslin, over which the upholstery material is

drawn and tacked to the edges. A valance of some pretty figured goods to match the seat and back is made, and tacked around the upper edge of the box. Wide gimp and large-headed upholsterers' tacks will finish the edge of the seat and back, and it would be well to give the wood-work a coat or two of paint or stain.

A Window-seat and Shoe-box

In the illustration of the window-seat and shoe-box (Fig. 26) a substantial and useful piece of furniture is illustrated.

It is made of three boxes screwed together, as shown in Fig. 27. The lid of the middle box is hinged, and the end boxes are stood on end. One end box is shorter than the other, and in both of them shelves are arranged for shoes, slippers, or sandals. A back is made of two boards and attached at the rear of the boxes. The top of each box and the face of the back are padded with curled hair or moss filling that may be had from an upholsterer, and covered with some upholstery material. Buttons and string are caught down into the top of the padded surface to give the tufted effect shown in the illustration, and the sides and fronts of the boxes are hidden with valances. Gimp and large-headed nails finish the edges as shown, and when the wood-work is given a coat of paint this window-seat and shoe-box is ready for use.

Chapter XXIII

HOUSEHOLD CONVENIENCES

IN and around the house there is opportunity for the creation of a number of useful articles that can be made by any boy who is at all handy with tools. For example, the tops of doorways and windows in a dining-room may be improved by the addition of narrow shelves, or ledges, on which old plates, slim jugs, or some quaint old bottles may rest.

These ledges may be made from pine, white-wood, cypress, or other wood to match the trim. The wood should not be more than half or five-eighths of an inch in thickness, as shown at Fig. 1. The shelves should be three or four inches in width, with a straight front, or slightly curved, as shown in Fig. 2. This curve is called a serpentine line, and may be shaped with a draw-knife; or, if the wood is soft, it can easily be cut with a compass-saw and finished off with a draw-knife and sand-paper.

Two brackets cut from wood the same thickness as the shelf will support it at either end. These are cut three inches wide at the top and from six to eight inches long, in the shapes shown in Fig. 3.

It gives a more attractive finish to extend the ends of the

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ledge two or three inches beyond the door or window trim, as shown in the illustration of Fig. 1.



FIG. 18.

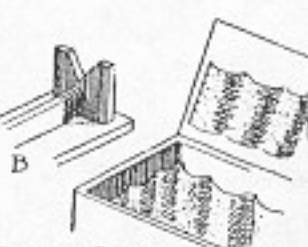


FIG. 21.

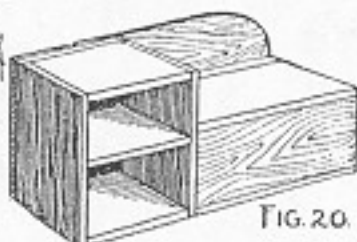


FIG. 20.

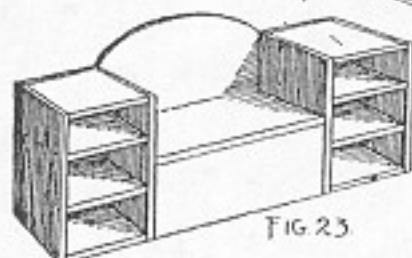


FIG. 23.

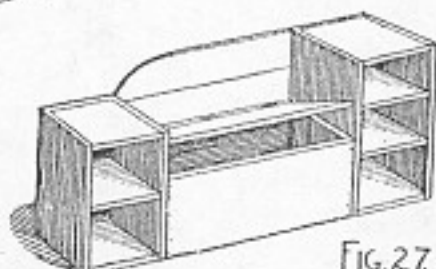


FIG. 27.

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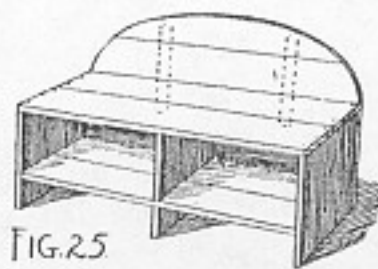


FIG. 25.

A Plate-rail

For cups and small pitchers a plate-rail may be arranged around the walls of a dining-room, as shown at Fig. 4.

A wall-plate six or eight inches wide is made fast to the wall about five feet up from the floor, and to it, at intervals of twenty to thirty inches, brackets are screwed fast. These are cut in one of the forms shown in Fig. 3, and are three inches wide. The top shelf is four inches wide, and is laid on the tops of the brackets and pushed back against the wall, where the rear edge is screwed fast to the top edge of the wall-plate. Where the rail meets a doorway or window-casing the corner is rounded, as shown in the illustration. This may be done with a compass-saw and small plane. A narrow strip of wood is nailed fast to the top of the rail about two inches out from the wall, to prevent the plates from sliding off.

A narrow plate-rail may be attached to the wall higher up, or about in the position occupied by a picture-moulding. Shorter brackets should support it, and they may be attached directly to the wall without the aid of a wall-plate, since the latter would give a heavy appearance to a rail at that height.

A Cup and Plate Rack

It is hardly advisable to give definite dimensions for the cup and plate rack (Fig. 5), since it should be designed in

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accordance with the amount of wall room that may be available. The rack shown in Fig. 5 is intended for a wall space three feet wide and seventy-two inches high. The two uprights are made of white-wood thirty-nine inches high, three inches wide, and half an inch thick. The lower

wide and twenty-one inches long. The dowels extend from three to six inches over each end, as shown in the drawing. From their under-sides cups may be suspended on hooks screwed into the wood. The front edges of the shelves are provided with a strip of wood fastened on with slim, steel-wire nails, to prevent the plates from sliding forward, as shown in Fig. 6, which is a plan of the arrangement of bracket, shelf, and dowel. The dowels can be had at a hardware store for two or three cents each, and from a quarter of an inch to the diameter of a small curtain-pole.

A Cup and Plate Pyramid

The cup and plate pyramid (Fig. 7) is another attractive dining-room feature and is very simple to construct. Three of the shelves are cut with a serpentine front, as shown in Fig. 8 A, and measure twenty-six, twenty-two, and eighteen inches respectively; while the top one is twelve inches long and cut as shown in Fig. 8 B. The shelves are six inches wide at the middle, and three of them are two and a half inches wide at the ends.

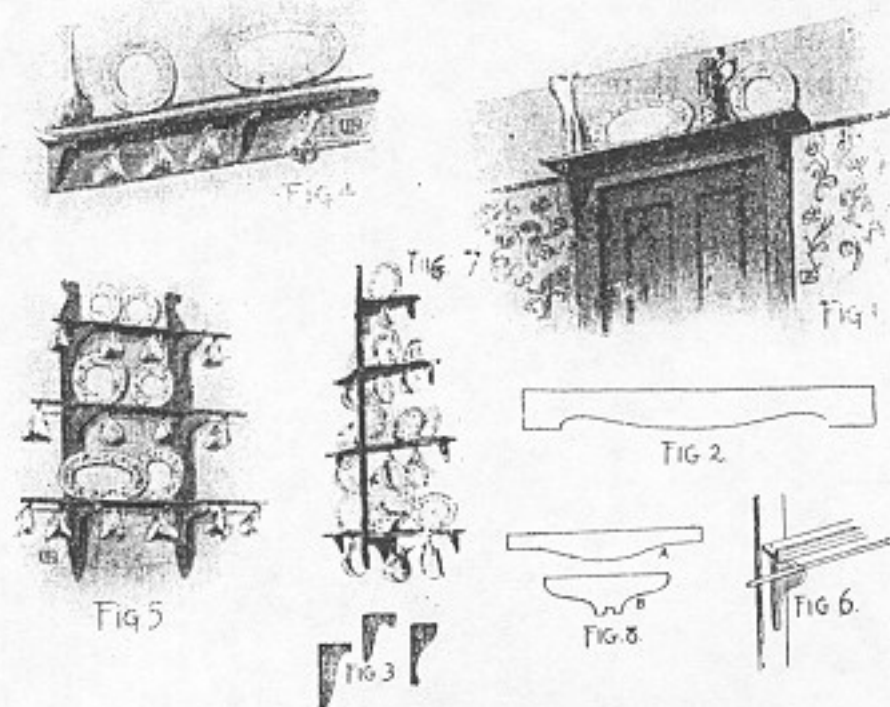
Short brackets one and a half inches wide and two and a half inches long support the shelves at the ends. Under the middle of the bottom shelf a large bracket five and a half inches wide and eight inches long is cut and made fast with long, slim screws driven down through the bottom shelf. A notch is cut at the front of each shelf, and a corresponding one in the staff that binds the shelves together, so that they are spaced, from the bottom up, eleven, ten, and nine inches apart. Slim, steel-wire nails two inches long will

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secure the brackets to the wall, or long, slim screws may be used.

A Butler's Tray

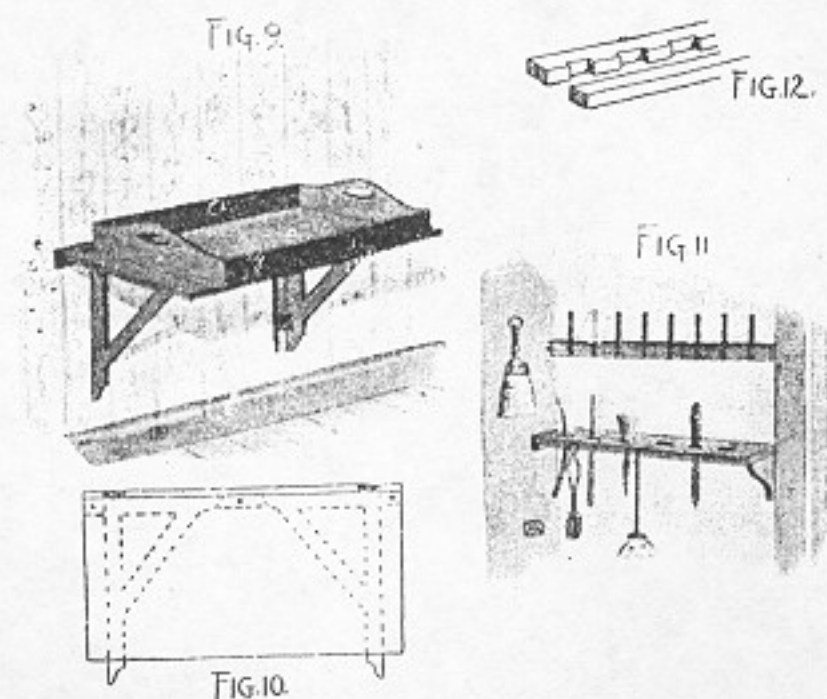
For the house that is not built with a butler's pantry, or for the mother who does her own housework, the tray and



ends are tapered, as shown in the drawing, and the upper ends are fashioned with a compass-saw. The brackets are six inches wide, nine inches long, and half an inch from the outer edge a depression is cut in the top to receive a half-inch dowel.

The shelves on which the plates rest are three inches

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drop-ledge shown in Fig. 9 will be found a very convenient piece of dining-room furniture.

Two brackets on hinges will support the shelf when it is

up. When it is dropped the brackets fold in against the wall, as shown in Fig. 10.

The ledge and brackets are of pine wood three-quarters of an inch thick and planed on all sides and edges. The

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tray is of white-wood five-eighths of an inch thick, and put together securely with glue and screws. The ends and handle-grips are cut with a compass-saw and finished with sand-paper; then the tray is stained and varnished to match the shelf and brackets.

Back of the drop-shelf a strip of wood two inches wide is fastened to the wall by means of a wall-plate securely screwed to the studding, and two vertical plates one inch thick make an anchorage for the brackets. The latter are attached by means of flat hinges, and the shelf proper is also hinged to the two-inch wall-plate. All these parts must be screwed very solidly together if the safety of the household crockery is to be considered.

Cup-pins and Brush-rack

In the butler's pantry or near the kitchen sink it is sometimes convenient to have a brush-rack and some cup-pins, on which cups, drinking-glasses, and small hollow-ware may be kept.

These are easily made, as the illustration (Fig. 11) will show. The cup-pins are dowels sawed in five-inch lengths, and then made fast to a square pine stick with slim screws passed through holes that have first been made with an awl. The rack is then attached to the wall with screws passed into the studs or uprights behind the plaster.

The brush-rack is made from two pine sticks, one of which is cut out in places, as shown in Fig. 12. The two sticks are then screwed together and supported on brackets. Brushes kept in a drawer or on a shelf do not dry properly,

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so that it is always best to place them where they have a free circulation of air.

Lock-shelves

In a cellar or store-room it is often convenient to have a portion of the shelves arranged so that their contents can be locked up. For this purpose Fig. 13 shows a slat door arranged in front of several shelves and hung on hinges. At the lower edge a hasp and eye may be made fast, so as to make a padlock available.

The slats are from one-half to seven-eighths of an inch thick and two inches wide; they are fastened to battens



FIG. 13.



FIG. 14.

with clinch-nails or screws driven from the inside. A smart boy can make any number of these doors so as to lock up a whole lot of shelving, but for convenience of handling they should not be more than four feet long.

A Vegetable-bin

For a corner of the cellar, and where it is convenient to the staircase, a very useful vegetable-bin may be made from

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a few boards and slats (Fig. 14). The bin may be of any width and length, but for a house of the average size, it need not be more than six feet long and eighteen inches wide each compartment being from sixteen to eighteen inches wide.

The front, back, and ends are ten inches high, and two of the partitions are the same height. The partitions for the potato and turnip compartments should extend eighteen inches above the top of the bin, since these vegetables bulk largely. The bin rests on two battens nailed to the brick or stone foundation-walls of the cellar, two feet above the floor. At the exposed corner a foot, or leg, twenty-four inches long, supports it. The bottom of the bin is made of long slats nailed an inch apart, so that the dirt from the vegetables will fall through to the floor, from which it can be easily swept up. The ventilation from the slat bottom prevents the vegetables from decaying as quickly as they would in a box or barrel with a tight bottom.

Across the tops of the high partitions, and propped up at the exposed end of the bin, a shelf or ledge ten inches wide will accommodate cabbages, lettuce, bunches of carrots and beets, parsnips, and various other vegetables. In the illustration only five compartments are shown in the main part of the bin, but a bin of almost any length can be constructed according to the space available and the requirements of the family.

A Spoon-bar and Saucepan-rack

For the kitchen, a rack on which to hang spoons, ladles, saucepans, cups, and other small accessories to the culinary department is shown in Fig. 15.

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It can be made to fit any wall space in a kitchen, but the brackets should be twenty inches high and ten inches wide at the top. They may be made from most any wood one and a half inches square, and put together with lap-joints. Three rails, seven-eighths by two inches, are attached to the inside of the front bracket-rails or supports, with long, slim screws or steel-wire nails. All the wood-work is painted two coats of white enamel, or any color to match the wood-work of the kitchen. Brass screws or galvanized nails are driven in the bars at regular distances apart, on which to hang the utensils, and the rack is then to be securely attached to the wall.

A Medicine-chest

Every house should contain a medicine-chest, where the necessary boxes and bottles containing the family medi-

cines may always be found in time of need. Chests may be made in any size and shape, and adapted to the spaces they may occupy on a wall or in a bath-room closet.

A convenient chest is shown in Fig. 16, and in Fig. 17 is given the plan of construction. For the average household it should be made eighteen inches wide and twenty-four inches high, with two shelves arranged so that the space between the lower one and the bottom of the box will be eight and a half inches. The space between the upper one and the top should be six inches, and between shelves seven and a half inches. The top and bottom wall-plates should measure four inches wide, and they are attached to the top and bottom of the box by means of screws driven into the edge of each through the top and bottom of the box.

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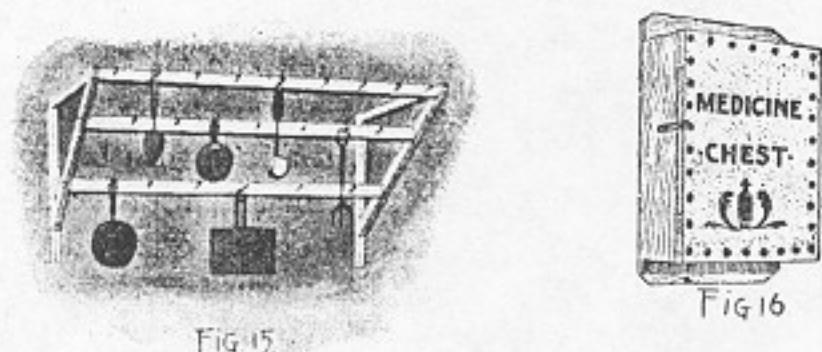


FIG. 15

FIG. 16

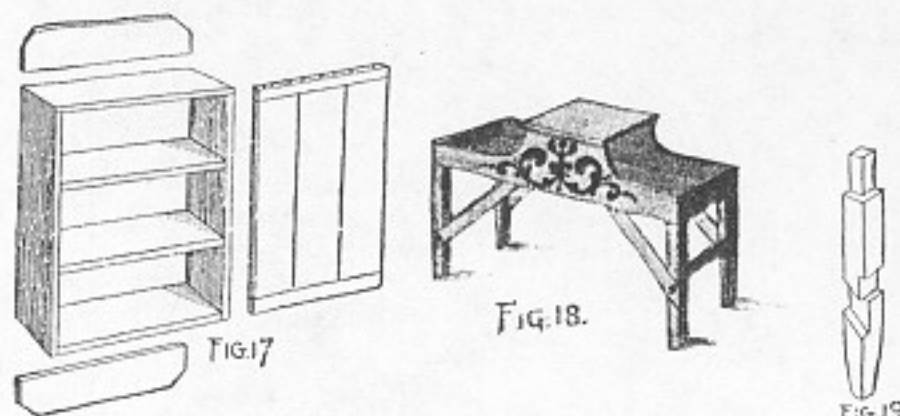


FIG. 17

FIG. 18

FIG. 19

A door is made from three pieces of board across the ends of which battens are made fast, as shown in the plan drawing. This is attached to the box by means of hinges, and a catch at the other side will keep it closed. The wall-plates and sides of the chest should be stained and varnished, and the door covered with burlap glued fast or tacked at the inner side. The letters, ornament, and imitation nail-heads are cut from sheet-lead, scraps of which can be purchased at a plumber's shop, shaped with a shears, or an old knife, and light mallet, and afterwards trimmed with

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a penknife blade or a file. They may be attached to the door with slim, steel-wire nails, and painted black with a coating made by adding dry lamp-black to thin shellac, and applying it in one or two thin coats with a soft-hair brush.

Be careful to anchor this chest securely to the wall, as bottles are heavy and their weight must be taken into consideration.

A Convenient Plant-tray

In the illustration of a convenient plant-tray (Fig. 18) an idea is suggested for a receptacle that will accommodate

several small pots in the lower tray and a large pot, or jardinière, on the middle deck.

The tray is thirty-six inches long and twelve inches wide and at the ends is four inches deep. But at the middle the sides are eight inches high, and support the stage or deck, which is thirteen inches square.

The tray is made of wood three-quarters of an inch thick and planed on both sides.

The legs are two inches square and twenty-four inches long, and at the bottom they are slightly tapered with a draw-knife and plane.

They are fastened to the inner side of the tray at the corners with long, slender screws driven down through the bottom of the tray and into the top of the legs.

Bracket-braces are let into the legs in lap-cuts made with saw and chisel, as shown at Fig. 19, and at the ends rails are let in between the legs to hold them rigidly.

The screws attaching these joints may be covered with mock nail-heads. The ornament at the side of the tray is

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cut from sheet-lead with a stout pair of shears, painted black, and applied to the wood with flat-headed tacks or gimp-nails.

An Indispensable Clothes-press

The available room in any clothes-closet can be more than doubled by adopting clothes-hangers and a rod. Fig. 20 shows the plan of a closet seen from above.

The projections around the outer edge represent hooks, while the bar through the middle and the cross-sticks represent the space gained.

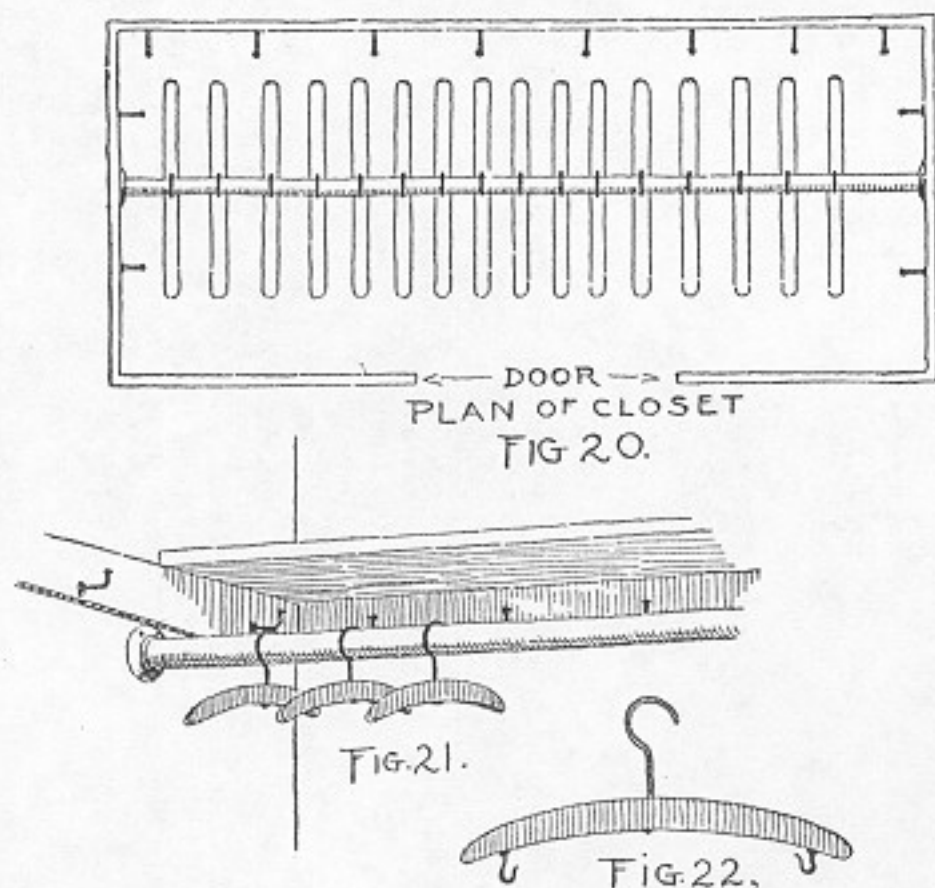
Fig. 21 shows the usual rail and shelf, but under them are the bar and hangers that represent the new feature. This is a great improvement upon the ordinary closet, even when drop-hooks are used under the shelves for the support of hangers carrying clothes. The work necessary for this arrangement is very simple.

Obtain two sockets and a small curtain-rod, and fit the rod into the sockets screwed to the wall under the hook-rail, taking care to drive long, slender screws through the plaster. From a hardware or house-furnishing store obtain a number of coat-hangers composed of a wood bar and iron hook. These can be had at all prices from two for five cents to twenty-five cents each, or if it is impossible to purchase them they can be sawed out of wood by any boy and provided with iron-wire hooks. The bars are eighteen inches across and slightly curved at the top, like one's shoulders. Underneath the bars, near the ends, small hooks may be screwed into place, on which trousers may be hung by using clamps (Fig. 22). In this manner

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from four to six suits can be hung to every running foot of the pole.

This method will keep the coat or trousers in shape. If loops are sewn fast to the skirt-band, the skirt will hang on the two lower hooks much better than on a single hook, when this system is applied to mother's or sister's closets.



This device is so simple and useful that once tried it will always be used, and where economy of space is a feature,

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this idea is a valuable one for both the city and country house.

A Divan

A comfortable divan banked up with pillows is always an inviting addition to a room, and helps to furnish it. In Fig. 23 an idea is given for a piece of furniture that will serve a double purpose—that is, a couch and a skirt or trousers press, with a compartment for shirt-waists or fancy waistcoats.

In Fig. 24 the box, or framework, is shown. It is five feet six inches long, twenty-eight inches wide, and fifteen inches high.

The tray is ten inches deep, and divided into a long and short compartment. This is supported by the ends, which are fifteen inches high, and made from several pieces of board with matched edges. Corner-brackets at front and back lend additional strength, and prevent the frame from racking.

The top, or lid, is made from several matched boards held together with two or three battens; it opens on three or four stout hinges securely screwed into the wood of the back.

A valance is made of some good upholstery material, and tacked all around the upper edge of the box. For the couch proper use a mattress which is to be placed on the lid, and covered with the cloth used for the valance. This should be tacked securely to the under side of the lid. This will hold the mattress in place and make a good finish for the edges of the top.

Make a few holes through the lid, and with a long needle

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pass a string up through them, through a stout button and down again, where the string is to be tied around a tack, and then the tack is driven in so as to hold the string

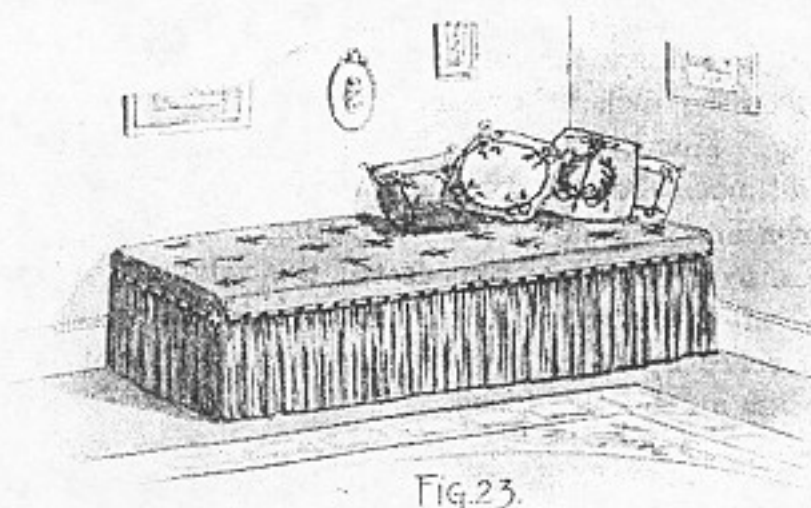


Fig. 23.

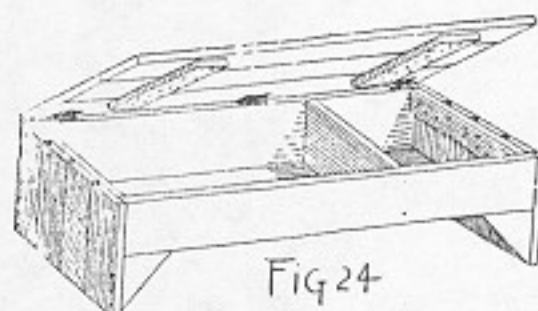


Fig. 24



LOUNGE AND CORNER DRESSING-TABLE

securely. This will give a tufted effect to the cushion top, and will make the mattress more secure.

Run a line of gimp or narrow belting around the top of the box over the tacks that fasten the valance, and with large, oval-headed upholsterers' tacks make a line of heads three inches apart all around the sides and front. This will make an effective finish.

A Corner Dressing-table

A very pretty dressing-table for the corner of a girl's room is shown in the illustration (Fig. 25). This can be made by a boy for his sister, or by a girl with a liking for such work. As shown in Fig. 26, it is built up on a sugar barrel, which is thirty inches high and twenty-four inches across at the widest place. When it is inverted, screws or nails can be driven through the bottom to hold the triangular ledge or table-top in place.

Three boards should be cut to form a quarter of a circle thirty inches long on the two straight sides, as shown in Fig. 26 A. The sweep, or curved edge, is one-quarter of a five-foot circle. Fig. 26 A also shows how this quarter-circle is placed on the top of the barrel.

To keep the boards together, two battens thirty inches long are nailed or screwed underneath the straight edges.

Screws rather than nails should be used in fastening the quarter-circle to the barrel. They will not pull out or work loose so readily as nails.

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The canopy top is supported on a framework consisting of three sticks, each three feet long, and a triangular top made of three short sticks, as Fig. 26 shows. At the top the sticks are joined as shown in B, and the lower ends are attached to the table-top with long, slim, steel-wire nails.

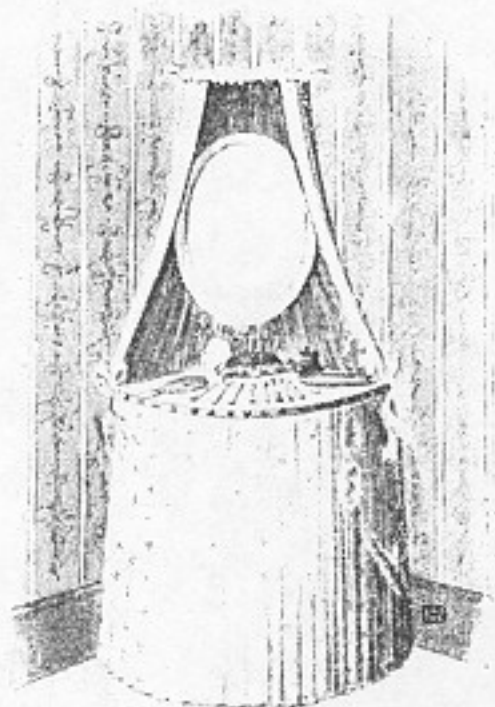
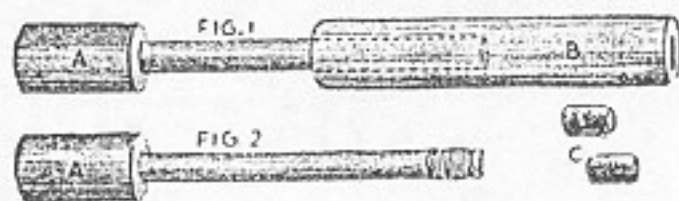


Fig 25.

If the color scheme of the room is pink, pale-green, or canary color, this same color may be carried out in the drapery. Sateen or colored cotton goods may be overlaid with a dotted swiss or scrim, and tacked to the framework.

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HOW TO MAKE A POP GUN



Select a straight length from an elder brush, and with a ramrod (A) made from a small dowel inserted in a spool, which serves as handle, push out the pith (B). Smooth the rod with fine sandpaper or a piece of glass. To smooth the inside of the barrel wrap sandpaper around the ramrod and push it to and fro. Now find two corks (C) that fit the barrel snugly but can be pushed through it with the ramrod. Rubbing the outside of the corks with wet soap will make them slip through more easily. Now push one of them in flush with one end of the barrel, put the other in the opposite end, and push the second one through with the ramrod—quickly. Pop! goes the first cork; and who knows what bear or lion it may bring down? If you want to turn your popgun into a syringe gun that will throw a stream of water several feet, burn a small hole with a hot wire through one of the corks and put the cork in the tube. Wrap a cotton string around the end of the ramrod (Fig. 2). The water will shoot out through the hole in the cork.

At the bottom a valance is made and caught to the circular edge of the ledge, which is covered with gimp held by brass-headed tacks.

The upper sticks of the frame are bound with strips of white muslin before the drapery is attached. This is to prevent the wood from showing through the goods, and also to make an anchorage in which some stitches can be taken, if necessary, to hold the canopy drapery in place.

For this top it will be necessary to have two swiss or thin scrim coverings, between which one thickness of the colored material is laid. Both sides of the drapery will be seen, and it is necessary to show the colored goods on both sides.

A shirred band of the goods may be arranged along the top stick of the canopy, and bows at the corners of the top and the edge will add to its appearance.

An oval or square mirror in a white or light enameled frame can be suspended by wires from the top.

The directions as to methods and the suggestions of designs given in this book open a broader and more inviting field, it is believed, than has been accessible in similar form before. That there is need of a new handy-book comprehensive, well tested, and designed on practical modern lines seems to be indicated by the popularity of the preceding volumes in this series: *Harper's Outdoor Book for Boys* and *Harper's Electricity Book for Boys*, which, together with *Harper's How to Understand Electrical Work*, form the modern "Boy's Own Library."

THE END



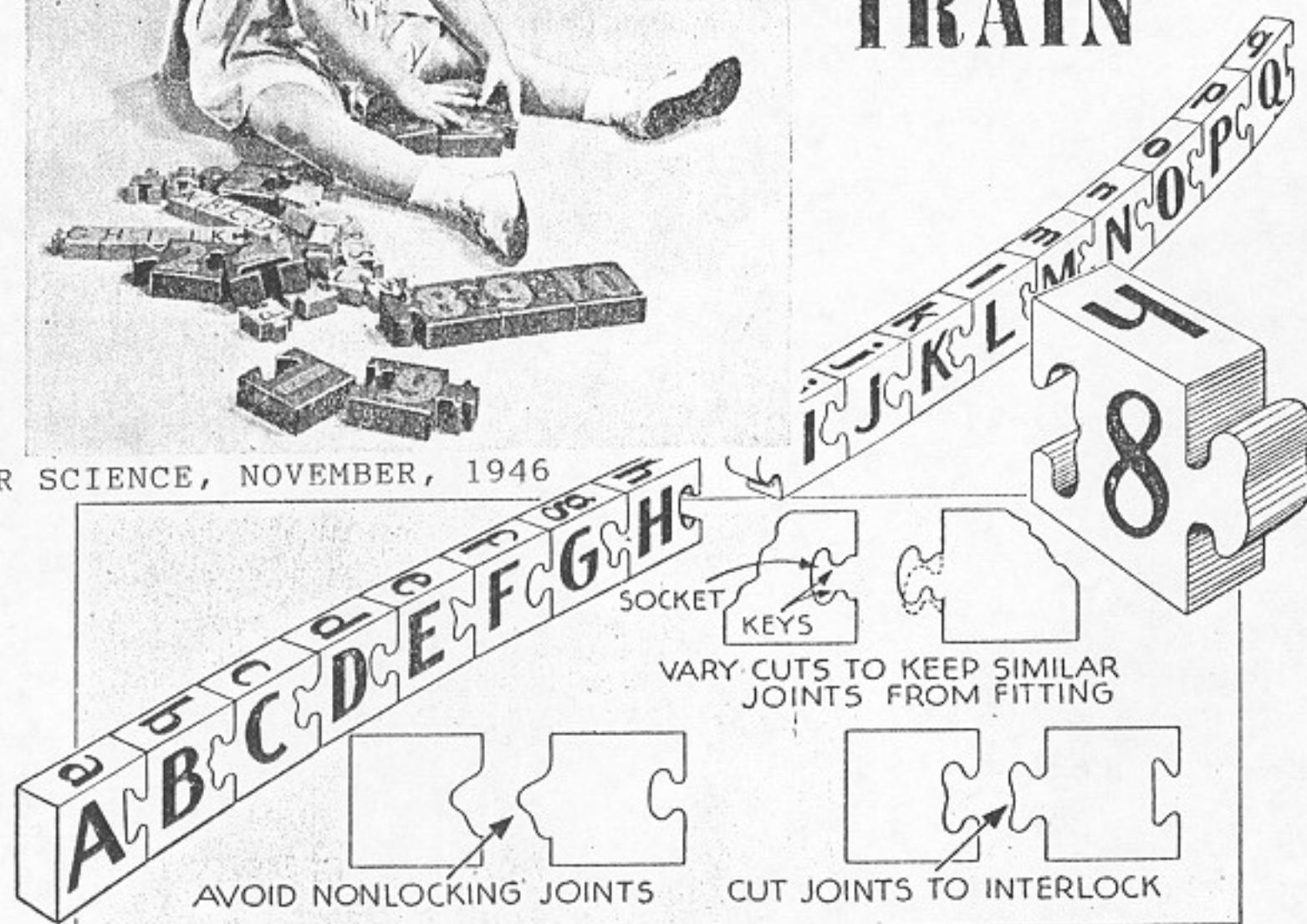
Fig. 1

Practically every boy wants a pair of STILTS, and there are plenty of girls who like them, too. There is no reason why anybody should be without them, for all that is needed for making stilts is two blocks of wood 1" thick and 4" square, and two taller pieces for handles. The smaller pieces, which will be the foot rests, you should saw to fit the foot, as in Fig. 1, and then nail securely to the handles. The length and thickness of these handles depends entirely on the height and weight of whoever is going to use them and on how high above the ground the young acrobat wants to walk. It is much the best plan to set the foot rests near the ground to begin with—say 6" above it—and move them up gradually as you become more expert in this new and exciting method of walking.



ALPHABET BLOCK TRAIN

POPULAR SCIENCE, NOVEMBER, 1946



BLOCKS have stepped out of the toy class. Given special shapes, they can be used to teach as well as amuse young children. The set illustrated above, for example, has dovetails locking the blocks into a train that can be snaked across the floor or even swung through the air. If all the joints were alike, it would merely be a simple toy; but if you shape each dovetail differently so that the train fits together only in proper alphabetical order, it will help teach a three-year-old the alphabet. Numbered blocks could teach him to count; and other sets might be made for anything else a child must learn in sequence, from script or lower-case alphabets to U. S. Presidents.

Construction of the alphabet train requires only a coping saw, some wood, and about an hour's time. Use hardwood approximately 1" thick, 1½" wide, and 39" long. Mark the board into 26 1½" pieces

and saw them out, following the principles suggested above. After sanding, paint and letter the blocks in the bright colors young children like. For the proper snakiness, the blocks should fit rather loosely. Use a thick blade in the saw and, if necessary, file down any surfaces that prevent the train from bending. The dovetails must grip firmly, however, so that the train will not fall apart easily, and they must be strong enough to withstand the inevitable rough handling of pre-school children.

Since the alphabet can seldom be taught easily to a child younger than three, two-year-olds will get most benefit from the simpler number train. Make this set in the same way as the alphabet train, but considerably larger, using wood 1½" thick, 3" wide, and 30" long. Cut into 3" squares, and this time shape very distinctive dovetails for simplicity.—STUART HOLT.

HOME WORKSHOP MANUAL 1930

BUILDING FURNITURE BY HAND

FOR the man who likes to make things, few pleasures compare with building fine pieces of furniture in a well-equipped home workshop. The cabinet woods in themselves are beautiful and pleasant to work with; the crisp cutting action of plane and saw have



FIG. 1.—This type of table, originally used in taverns, is highly prized by collectors of American antiques.

a music all their own; and every stage of the work, from jotting down the cutting list to the last stroke of the polishing cloth, is of utmost interest.

The problems involved in cabinet work, such as laying out and making joints, are less difficult than commonly believed. Many of the processes the ama-

teur woodworker is likely to encounter are discussed in following chapters, but there is nothing in the technic of wood-working which cannot readily be mastered. Where beginners are apt to fail is in selecting designs. It is no more difficult and, indeed, often easier, to make a well-designed piece of furniture than something that is clumsy and unsightly.

In this chapter designs will be given for constructing reproductions of several Colonial pieces of noteworthy design and for making some modern pieces which are especially adapted for the amateur cabinetmaker who has to rely mainly, if not entirely, upon hand tools. Of course, if small wood-working machinery is available, the same methods outlined in Chapter III can be used for making the pieces of furniture illustrated and described in this chapter.

COLONIAL TAVERN TABLE

Tavern tables were among the earliest types developed in this country and were very common before the Revolutionary War. The few to be found today are highly prized by their owners. They were made with round, oval, or square tops and varied from the size of this one to a length of 4 ft. or more.

Reproductions are popular because a table of this type blends well with almost any style of modern furniture (Fig. 1). We see them used as side tables and radio tables and for holding smoking sets; in fact, everywhere in the home.

This table is made of maple, except for the one-piece top, which is pine. It has seen a lot of hard use and has been painted a number of times. At present it is finished in its natural color and has two coats of white shellac and one coat of wax—a most beautiful finish.

Because screws were unknown when this table was made, the joints are reinforced with wooden pins or dowels. Even the top is held down with pegs; and no metal is to be found in its construction.

A copy can be made of almost any kind of wood, and the finish is entirely a matter of choice. To make the legs requires the use of a lathe, but if you have none, you can have the legs made by a local wood turner or cabinetmaker.

To get the best results in turning the legs, it may be advisable first to lay out the shape full size on paper (Fig. 2).

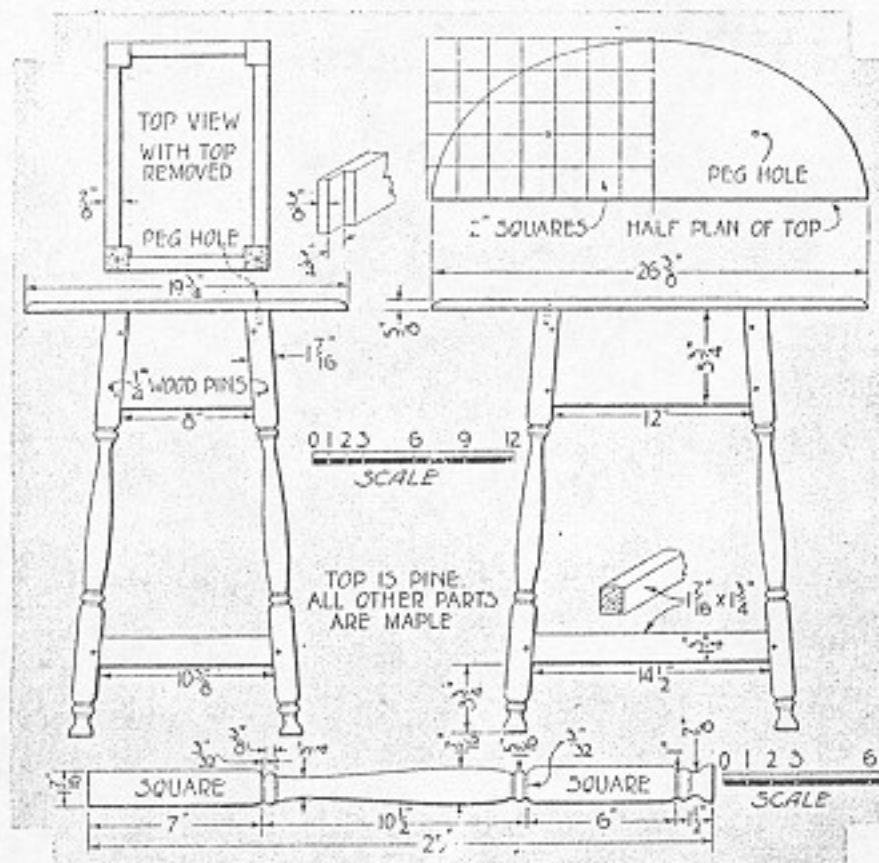


FIG. 2.—Measured drawings of a genuine Colonial tavern table: side and front views, the framework, half plan of the top, and details of the legs, joints, and stretchers.

Two sections of each leg are left square. Sandpaper the turned work in the lathe as smooth as possible.

The stretchers at the bottom and the rails under the top are mortised and tenoned into the legs. The stretchers are as thick as the legs, but the rails are only $\frac{7}{8}$ in. thick. However, all the rails are flush with the outside of the table legs, as shown in the top view.

To find the correct angle in cutting the rails and stretchers, lay out a full size drawing of the end and side views of the table. Don't forget to allow about $\frac{3}{4}$ in. for the tenons on each end.

After all your joints are made, glue

MATERIALS FOR TAVERN TABLE

No. Pcs.	T.	W.	L.	Parts
1	$\frac{5}{8}$	19 $\frac{1}{2}$	20 $\frac{3}{4}$	Top
4	1 $\frac{1}{16}$	1 $\frac{1}{16}$	25	Legs
2	1 $\frac{1}{16}$	1 $\frac{1}{16}$	16	Long stretchers
2	1 $\frac{1}{16}$	1 $\frac{1}{16}$	11 $\frac{3}{8}$	Short stretchers
2	$\frac{3}{8}$	5 $\frac{1}{4}$	13 $\frac{1}{2}$	Long rails
2	$\frac{3}{8}$	5 $\frac{1}{4}$	9 $\frac{1}{2}$	Short rails

All dimensions are in inches. The top on the original table is pine. The other stock is maple. Each dowel is about $\frac{1}{4}$ in. in diameter, and the ends of the pegs are almost square.

the end frames together. Wipe off the surplus glue and put the frames aside until the glue hardens. In the meantime you can work on the table top.

No doubt you will have to use two

or more pieces for the top; a board $19\frac{3}{4}$ in. wide isn't always available. Three 7-in. boards are suggested, as this will allow enough extra stock to be planed down to the finished measurements.

An easy way to lay out the oval shape is to cut out a heavy paper pattern $9\frac{7}{8}$ in. wide and $13\frac{3}{16}$ in. long. Rule this paper off into 2-in. squares, starting from the lower right-hand corner. Now refer to the crosslines shown on the drawing and point off your outline on the paper pattern. Connect the pencil points with an easy, graceful curve and cut the design with a pair of shears.

Place your pattern on the table top, which should measure exactly $19\frac{3}{4}$ by $26\frac{3}{8}$ in. Have the pattern touch one end and one side and mark the outline. Repeat this on the other three corners. You are now ready to remove the extra wood and spokeshave down to the line. The upper edge of the top should be rounded over and sandpapered.

Glue the end frames, the 12-in. side rails, and the $14\frac{1}{2}$ -in. stretchers together. Proceed as before and test your work with a steel square to be sure the frame is true.

The top can be fastened down with angle irons on the underside or pegged into place as in the original table. Whether you dowel all your joints and the top depends upon how closely you wish to copy the original table.

As the legs do not stand in a vertical position, each one will have to be filed or sawed a little at the bottom. A coarse

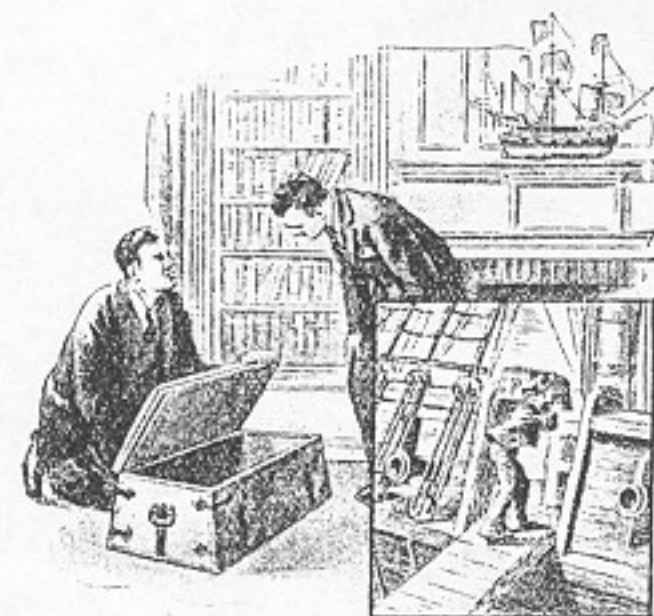


FIG. 3.—A chest as well proportioned and decorative as this is worthy of display in any room, particularly one with Colonial furnishings.

wood rasp will serve very well, and a level bench, table, or floor will do to test the work on.

The finish depends upon the kind of wood from which the table is made. If you select mahogany, walnut, or gumwood, an oil stain, filler, and varnish

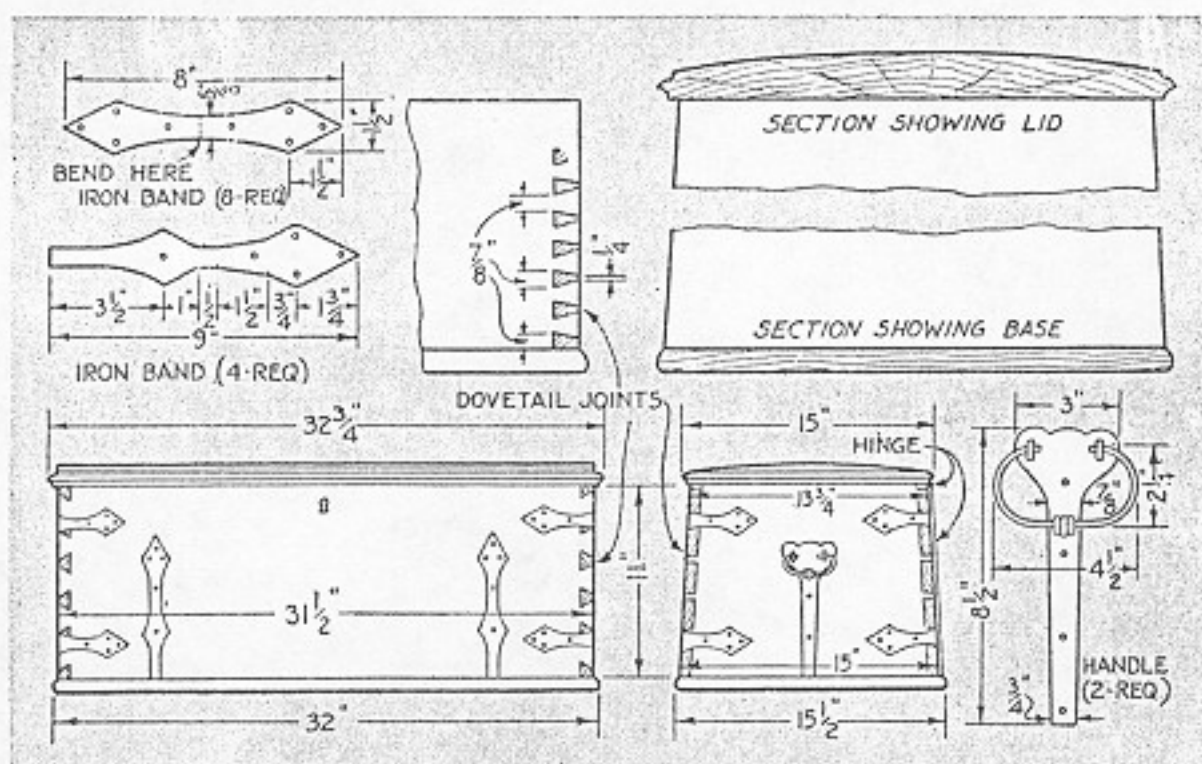


FIG. 4.—Drawings prepared from sketches and measurements made by Frederick J. Bryant in the Marine Room of the Peabody Museum, Salem, Mass. The original chest is of pine.

may be used. Colored enamels or brushing lacquers will also give good results.

ANTIQUE SEA CHEST

During the past few years there has been a tremendous interest in ship model making, and many of those who are indulging in this fascinating hobby have collected a variety of special tools, books, and pamphlets on ship models, templates, and other accessories. It seems appropriate, therefore, to offer a drawing of a genuine old-time sea chest (Fig. 3) in which to store these materials. Aside from its quaint charm and fascination, the chest can be used for this or a number of other purposes.

This chest (Fig. 4) is one of a number in the marine room of the Peabody Museum at Salem, Mass. It was chosen because it is not too large, is not difficult to build, and is attractive in appearance. The cost of the lumber—only from twenty to twenty-five board feet of white pine—is only a few dollars.

The design can be altered in various ways, if desired, to suit individual requirements. For example, the interior can be lined with red cedar, or rope handles can be substituted for the metal ones. A chest of a decorative type, but not so practical, can be made by using a flat cover without any overhang, on the top surface of which is drawn an ellipse measuring, say, 7 by 12 or 8 by 14 in. Within this oval may be painted a picture of a sailing vessel or a marine view.

To make an exact copy of the original chest, select two pieces of white pine $\frac{3}{4}$ in. thick, 11 in. wide, and $31\frac{1}{2}$ in. long. The two pieces for the ends are

$\frac{3}{4}$ in. thick, 11 in. wide, and 15 in. long at the base and $13\frac{3}{4}$ in. long at the upper edge.

Making the dovetail joints is not a difficult process. A careful layout, sharp tools, and a little patience will insure good results. First select the front side and score a sharp knife line across the board and $\frac{3}{4}$ in. in from the end. Do this on all four boards and on both outside and inside surfaces. On the boards for the front and the back measure off with a pair of dividers or compasses a series of $\frac{7}{8}$ -in. spaces (see the detail drawing of the dovetails).

Next take a piece of scrap wood, place a knife line $\frac{3}{4}$ in. in from the edge, and lay out a full size dovetail, measuring $\frac{7}{8}$ in. at the back and $\frac{1}{4}$ in. at the edge.

From this layout or pattern of one dovetail, set your sliding T-bevel to determine the slope of the sides. Then set the bevel against the $\frac{7}{8}$ -in. measurements on the front board, hold it firmly, and mark the lines with a knife. Now pass the lines across the ends of the board, using a try-square. Finally, score the lines on the inside of the board, using the bevel again. All the dovetails on both ends of the long pieces should be alike.

Place the board in a vertical position in the vise and saw very carefully just inside the knife lines with a dovetail saw or a fine backsaw. Chisel out the stock between the cuts, being careful not to cut beyond any knife line. Some may prefer to place the board down on the bench and remove the surplus wood with a chisel and a mallet. Every dovetail should be clean-cut, and all uneven spots must be cut away.

The next step is to cut the tenons or pins in the end boards. See that the stock checks up with the measurements on the drawing. Place one piece in a vertical position in the vise and set one of the long boards in position on it, lined up corner to corner. Hold it so that it cannot move and with a sharp knife transfer the outline of the dovetails to the ends of the short board. It is a good practice to number the corners of your chest and check these numbers each time the corners are mated.

Take the long board out of the way and square the knife lines from the end layout down each side as far as the $\frac{3}{4}$ -in. line. This time you are to cut away the stock between the dovetail marks (see the end view of the chest, Fig. 4, page 6).

Next try to assemble the chest, but do not glue it yet. Check the corner numbers and press the joints together; do not pound the work with a mallet. See that all parts fit snugly and test the assembly with a steel square. If everything is satisfactory, you are ready to glue the joints. Any defective work can be remedied by using a plastic wood composition.

The bottom of the chest is $\frac{3}{4}$ in. thick and extends $\frac{1}{4}$ in. beyond the sides and ends of the box. This edge is rounded over. As the sides slope somewhat, it will be necessary to "level off" the upper and lower edges of the chest before fitting the cover and base. Screws and glue are usually used to fasten the bottom of the chest.

The cover is rather unusual. It is evidently a plank about $1\frac{1}{4}$ in. thick. Along the outside edge it is only $\frac{5}{8}$ in. thick and has an overhang with a molded edge of the same dimensions. Some of the overhang over the hinges may have to be reduced to allow the cover to be opened wide; this depends upon the offset of the hinges used.

The iron trimmings on the original chest are handmade. The material is quite thin and appears to be hammered. The hinges, which are made of two strips of stock $\frac{3}{4}$ in. wide, pass underneath the cover. On the backboard each hinge extends down as far as the bottom. The hinges are placed $5\frac{3}{4}$ in. in from the corners of the chest.

The handles also are handmade, and the balls are made of round stock with three knurls or knobs in the center. All the iron fittings are painted black. Ready-made hinges and handles may be used if an exact duplicate is not desired. An iron lock with a small escutcheon for the keyhole is necessary to complete the fittings.

Whatever kind of stock you may use, it is well worth your while to sandpaper the chest inside and out as thoroughly

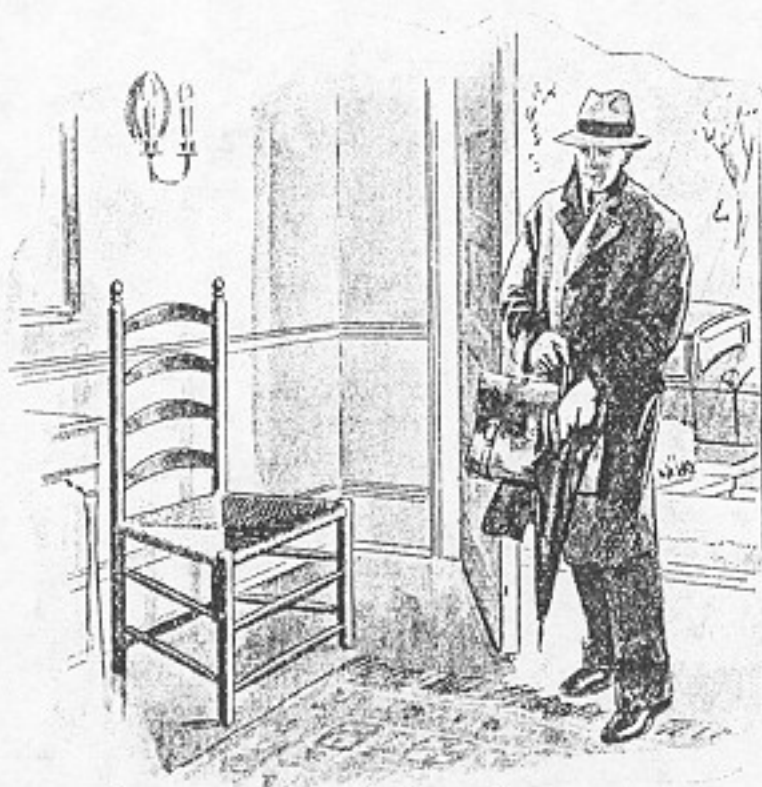


FIG. 5.—Handmade reproductions of this type of chair are highly prized for their decorative quality and antique look.

as possible.

If your chest is made of white pine, it will look well finished with oil; or one coat of white shellac and another of varnish will make a fine contrast with the black iron bands and trim. Sea chests sometimes were painted, and you may prefer to paint yours in an attractive color.

"LADDER-BACK" CHAIR

This "ladder-back" chair, which takes its name from the arrangement of the slats forming the back, is a good specimen of some of the earliest chairs made in this country. Chairs of this type, because of their decorative appearance and Colonial associations, are popular and in demand for use in a hallway (Fig. 5), living room, or bedroom. They are not, it must be admitted, especially comfortable.

The design illustrated in Fig. 6 was chosen because it is not difficult to copy. The back legs are plain except for the upper ends. The irregularly shaped knobs may be part of the legs or turned separately. Another feature is the fact that this chair can be made without a lathe.

It may be well to cut and fit the mortises before rounding over the legs by hand or turning the stock in a lathe. If

the stock is left square until the slats are fitted into place and the holes are made for the rounds, it is a simple matter to lay out the work.

Soft pine fillers can be placed temporarily into the mortises if the legs are to be turned. The fillers will prevent chipping near the edges. All of the mortises and holes should be about $\frac{3}{4}$ in. in depth. Wooden dowels or pins are used to strengthen the slat joints.

To make the back legs by hand, plane the stock exactly square with the base $1\frac{3}{4}$ in. and the top $1\frac{1}{8}$ in. On the larger end measure in from each corner exactly $\frac{1}{2}$ in. Connect these points cornerwise and you will have laid out an eight-sided figure—an octagon. Do the same on the smaller end, measuring $\frac{7}{16}$ in. instead of $\frac{1}{2}$ in. With the aid

of a straight stick, draw lines the full length of the posts to connect these corner measurements. Now plane or bevel the corners of the leg, being careful not to cut below the bevel lines. All of the bevels should measure about $\frac{5}{8}$ in. wide at the big end.

As the next step, remove the remaining corners with a plane. The knobs at the top can be omitted if necessary. After this comes the scraping, filing, and sandpapering. The front legs are made in the same manner.

The seat rounds are $\frac{3}{4}$ in. in diameter, and on them is woven the rush or fiber seat. Rush was used on the original, but fiber is easier for the amateur to handle.

MATERIALS FOR "LADDER-BACK" CHAIR

Parts	No.	Dia.	Length
Legs—back	2	$1\frac{1}{4}$	$38\frac{1}{2}$
front	2	$1\frac{1}{8}$	16
Rounds—front	2	1	$18\frac{1}{2}$
side	4	1	$12\frac{1}{2}$
back	1	1	$12\frac{1}{2}$
seat	1	$\frac{3}{4}$	$12\frac{1}{2}$
seat	1	$\frac{3}{4}$	$18\frac{1}{2}$
seat	2	$\frac{3}{4}$	13
Slats, bowed	4	$\frac{5}{16}$ by $2\frac{1}{2}$ by 13 long.	

Fiber or rush sufficient for one seat.

The stock is maple. All dimensions are in inches.

Simple printed directions are usually given with the fiber when it is purchased.

The chair rounds below the seat are

$\frac{3}{4}$ in. at the ends and 1 in. in the middle. These are usually shaped by hand. Only one round is to be placed under the seat and between the back posts; this is on the same level as the bottom one on the front side. As a matter of fact, I could find no sign of a rear round on the old chair, but for additional strength it seems advisable to include one.

The slats are only $\frac{5}{16}$ in. thick. As they are bowed slightly, each piece can be steamed or soaked in boiling water and then clamped to a form. Another way is to shape each slat from a piece of stock 1 in. thick with the aid of a spokeshave.

At the present time many old chairs of this type are being re-finished in modern ways. Some are even painted jet black with touches of gilt or bronze paint; others are given a dark brown or chocolate color. For an antique maple finish, a very light walnut stain may be used and wiped or sandpapered off in places here and there over the surface to give a high-lighted effect.

CHESTS IN POPULAR DESIGNS

When we consider the beauty, the romance, and the practical value of the cedar chest, we wonder what piece of furniture offers the amateur craftsman more satisfactory returns for his work. This section discusses the major points to be considered in making a Colonial and other popular types of cedar chests.

Thoroughly weather-dried red cedar, if obtainable, will yield more of the characteristic odor of cedar, but kiln-dried lumber will hold its shape better. Often a pine or whitewood chest can be lined with $\frac{3}{16}$ -in. red cedar, though as far as the safety of the contents is concerned, cedar may be omitted and the goods laid away in naphthalene flakes.

Cedar is prized for its beauty, its odor, and the sentiment attached to it through its long use in chests, but for all practical purposes any good cabinet wood will serve for making the chests illustrated. Plywood can be used by adapting dimensions to the differences in thickness; this will eliminate all gluing of wide boards.

Red cedar boards are seldom more than 8 in. wide and usually have many blemishes, but we must be thankful that the unwise lumber waste of the past has left us even these. They should be planed $\frac{3}{4}$ or $\frac{7}{8}$ in. in thickness, as may be required. If a tray is desired, one of the poorer boards may be resawed and planed to $\frac{3}{8}$ in.

Saw out the boards to 1 in. longer

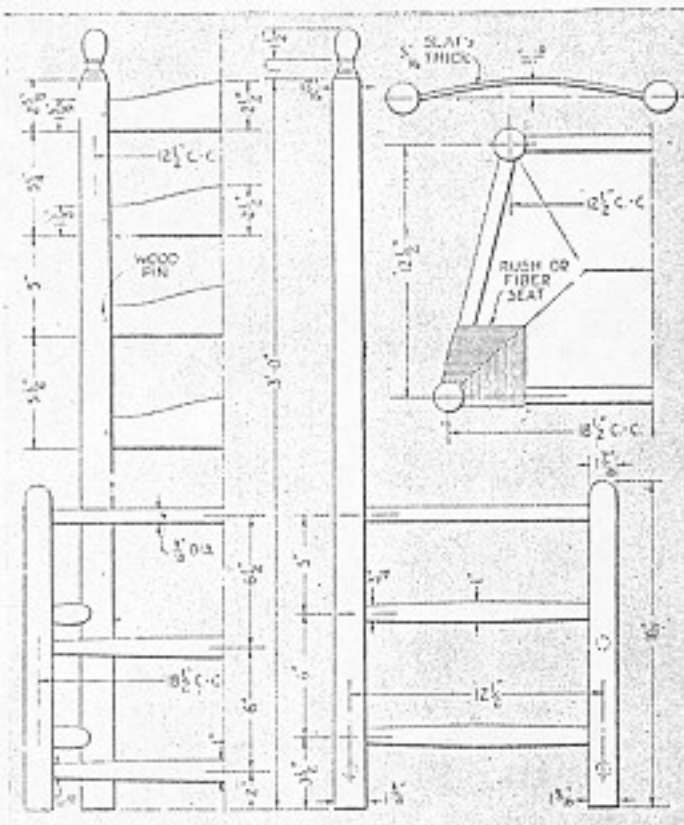


FIG. 6.—Measured drawings of Colonial "ladder-back" chair of fine proportions and unusual simplicity.

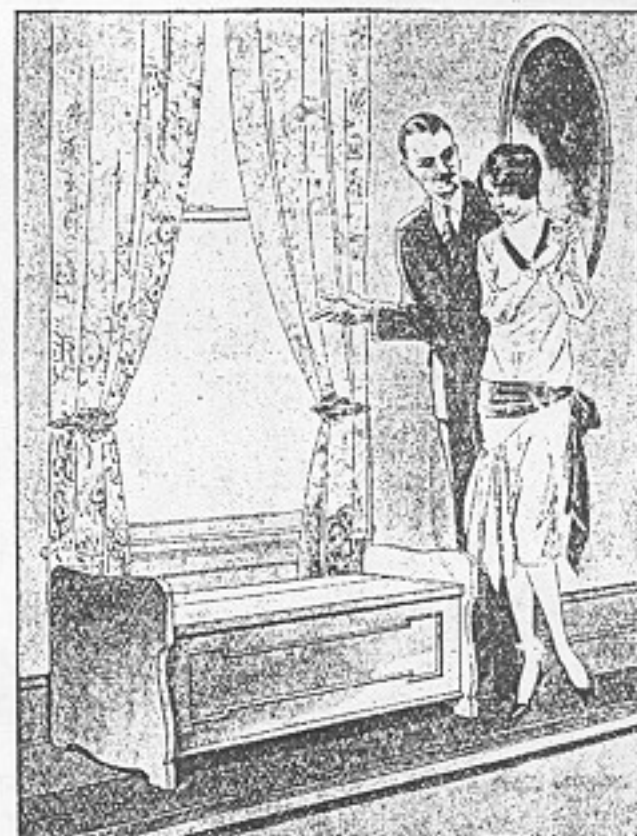


FIG. 7.—An attractive and practical chest seat. For the working drawings, see Fig. 11.

than required and make a liberal allowance for width. Joint (plane) the edges for gluing. The simplest joint—the plain glued joint—is the best for this work, for the matched and splined joints are more suitable for machine fitting.

Dowels may be located by driving small brads about halfway in one of the edges to be joined at the points where the dowels are required and cutting them off so as to leave about $\frac{1}{8}$ in. projecting. Carefully place the two boards together and rap them sharply with a mallet.

Separate them and pull out the brads. The small holes will be in perfect align-

ment and will indicate where to bore the dowel holes in both edges.

After the boards have been glued, plane them roughly to a straight surface and to an even thickness at the ends. Select the face sides of all pieces, joint the best edge of each, mark and saw the lengths accurately with a fine saw, and plane the parts to accurate widths.

The Colonial chest illustrated in Fig. 8 is assembled by fastening the end pieces to the sides with $1\frac{1}{2}$ -in. No. 9 screws and hiding the screw heads with plugs. Bore a $\frac{7}{16}$ -in. hole as at A $\frac{1}{4}$ in. deep, and drill a $\frac{3}{16}$ -in. hole the rest of the way. Make the plug by sawing $\frac{1}{2}$ in. from the end of a $\frac{1}{2}$ -in. board and

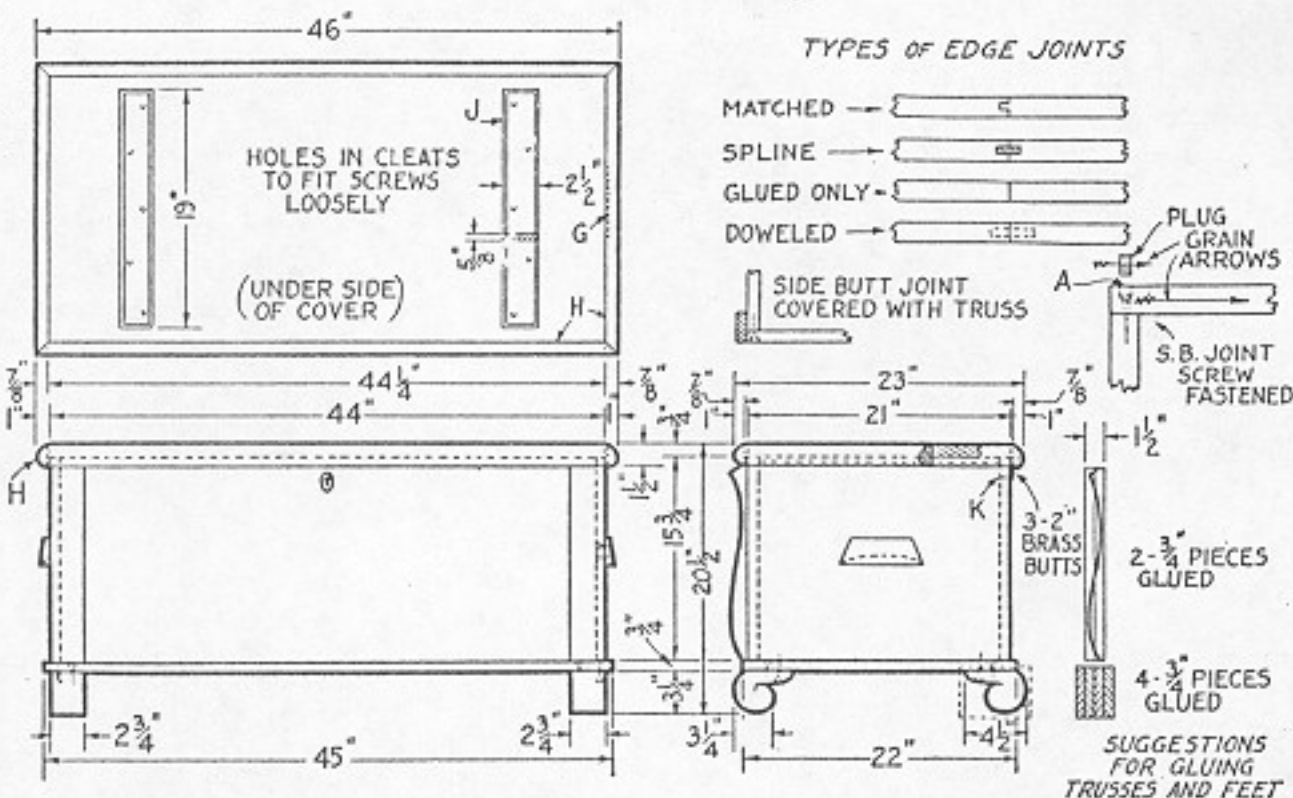


FIG. 8.—Colonial chest with various types of edge joints—matched, splined, butted and glued, doweled, and two kinds of side-butt and screwed joints. Any of these can be used, of course, in making any type of chest.

planing, whittling, or filing it round and tapered so it can be driven closely into the $\frac{7}{16}$ -in. hole. Drive the screw; then glue and set the plug in the hole. The grain of the plug should coincide with the grain of the surface. Later on the plug can be trimmed flush with the board.

Chests may be assembled by several other methods illustrated in Figs. 9, 10, and 11.

In the high chest (Fig. 9), the open dado joint *B* is assembled by means of $1\frac{1}{2}$ No. 8 screws driven a little slantingly. The countersunk screw holes and the joint are covered with a strip.

In the Hepplewhite chest (Fig. 10), the dado or milled corner *C* requires the use of a circular saw; the grain at *I* is a weak place. The half-and-half joint at *D*, nailed two ways and with the nails set and the holes filled with putty, makes a good joint. The mitered and splined joint *E* is the best joint shown; it is strengthened by splines 2, made of veneer and glued into slanting saw cuts of suitable width.

The construction of the seat chest (Figs. 7 and 11) permits a simpler form of corner. The sides and ends may be securely nailed as at *F*.

A chest bottom should be perfectly square and fastened to the bottom with sixpenny finishing nails or with screws, say $1\frac{1}{4}$ No. 9 in size.

The trusses and feet may be made from $\frac{3}{4}$ -in. pieces cut larger than required, glued together, sawed, and the curves smoothed with spokeshave, file, and sandpaper. Fasten these in place with glue and with nails or screws.

Handles may be made of $\frac{7}{8}$ -in.-thick wood hollowed underneath and fastened with glue and screws.

Make the cover $\frac{1}{8}$ in. larger all around than the body of the chest, with square edges and true angles. The molding *H* (Colonial chest, Fig. 8) around the cover is $\frac{7}{8}$ by $1\frac{1}{2}$ in. It is fitted to the edge, mitered, and fastened with glue and sixpenny finishing nails. Place the glue in the middle of the end as at *G*, which will allow the cover to shrink and swell without twisting. Take the same precautions in fastening cleats *J* with glue—that is, apply the glue only at the center—and have the screw holes fit the screws loosely. The edge of the cover should project 1 in., but it may be $\frac{1}{16}$ in. less so *H* will just clear the body.

Regular chest hinges, which have one leaf offset, as shown in the upper left-hand corner of Fig. 12, are ordinarily used. The offset leaf is attached with screws to the upper edge of the back of the chest and to the inner surface of the back. Hinges of this type can be obtained at the larger hardware stores and manual training supply houses.

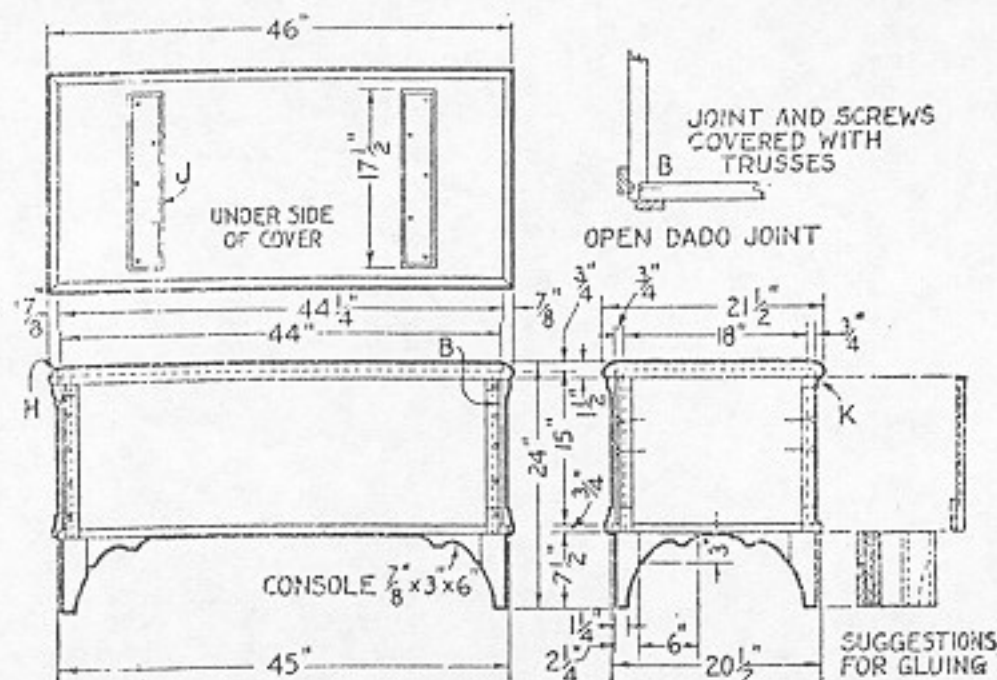


FIG. 9.—High chest with shaped legs. It gives a lighter and more graceful impression than a low, boxlike chest.

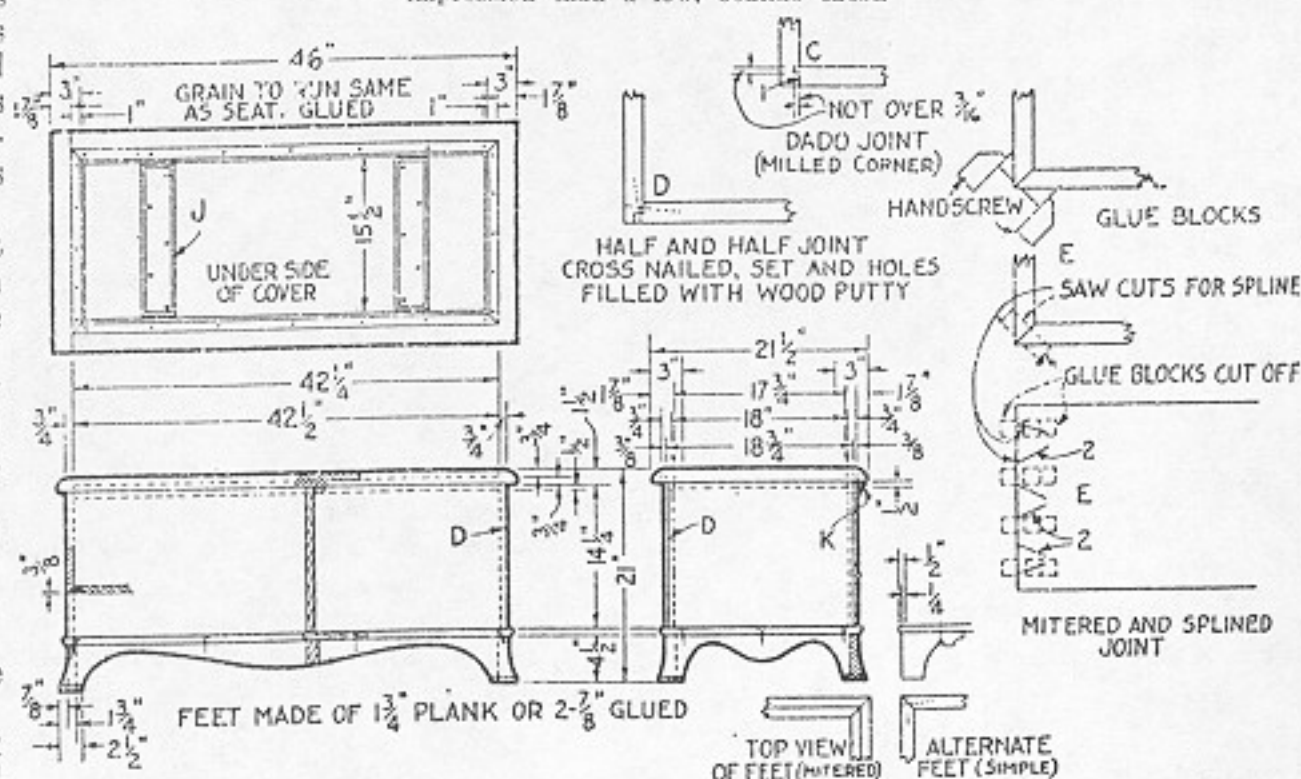


FIG. 10.—Hepplewhite chest with details of the legs and various types of corner joints.

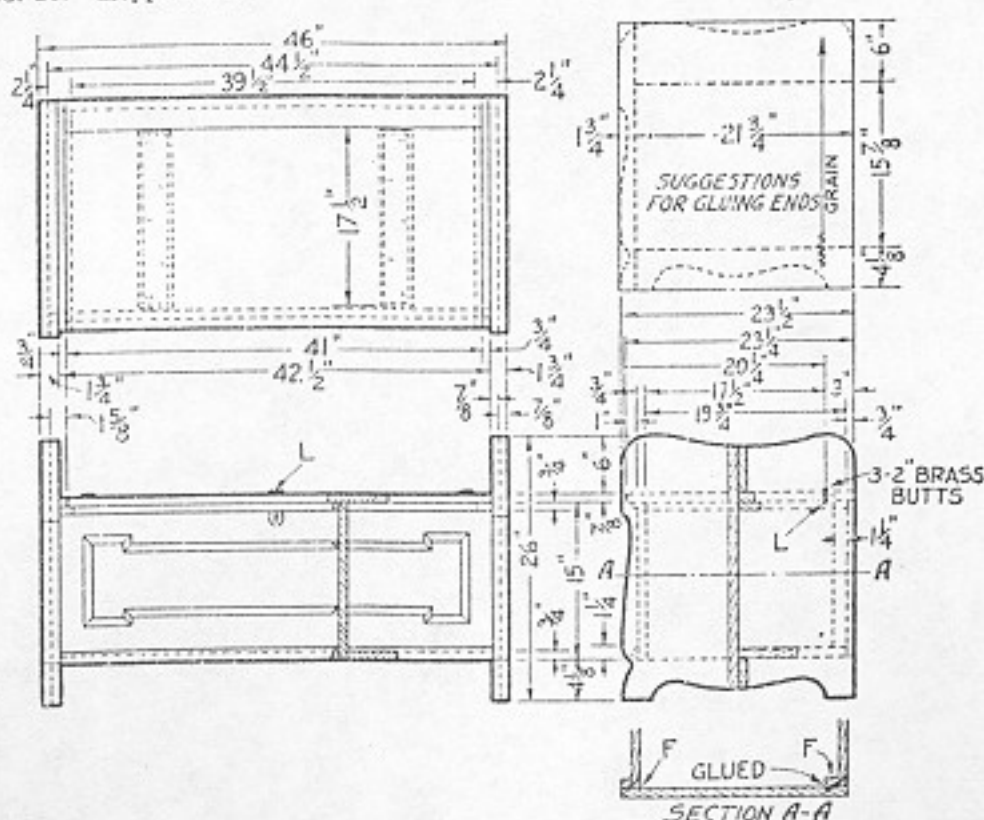


FIG. 11.—Dimensioned drawings of the chest seat. Compare with Fig. 7.

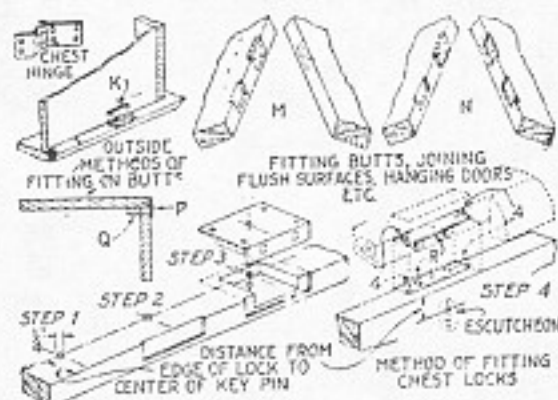


FIG. 12.—A chest hinge; various methods of applying butt hinges; the steps in fitting a chest lock.

Ordinary butt hinges *K* also can be used and, of course, are obtainable anywhere. To apply them, lay the cover and chest upside down; place the butts and drive the screws while in that position. If the cover and back are flush, the hinges may be placed as at *P*. In that case, a strip $\frac{1}{2}$ by 1 in. in cross section should be fastened to the inside of the cover as at *Q* to make the joint tight.

Fasten a piece of chain, strap, or webbing about 18 in. long from the chest to the cover, inside, to prevent the cover from falling too far back.

Butts placed at *L* in Fig. 11 may be cut entirely into the cover (as shown at *M* in Fig. 12) or one half their thickness may be set into the cover and half into the back piece, as at *N*.

Fit the chest lock by following the steps illustrated. Place the striker *R* in the lock and turn the key; drop the cover on the striker and the points 4 will mark the underside. Raise the cover, place the striker in the marks accurately, and mark carefully around the plate with a knife. Sink the depth of the plate until the cover will be held firmly when the chest is locked. After the chest has been finished, the escutcheon may be fastened in place.

The chest may be finished on the outside in its natural color or stained. Give the wood two coats of shellac and two of rubbing varnish or rubbing lacquer. Rub the undercoats with No. 4-0 sandpaper, and, if varnish is used, rub the last coat with powdered pumice stone and oil. Do not finish the inside in any way or the aroma of the cedar will be destroyed.

Some manufacturers sell knocked-down cedar chests in a variety of designs. These usually have finely machined corner joints so that the parts practically lock together. Their assembly is, therefore, a simple matter.

Manual training supply dealers and stores which carry hardware specialties often have on hand a supply of special hardware for chests, including copper bands, corners, hinge plates, escutcheons, handles, and chest lid supports.

LACQUERED CABINET MADE FROM OLD WASHSTAND

Chinese lacquered cabinets are fashionable, and the prices asked for high-class ones are prohibitive. It is not a difficult task to make one, however, especially if an old washstand can be found in the attic or at a second hand furniture store to serve as the box part.

The cabinet illustrated in Fig. 15 was made by Marie Childs Todd, an art teacher in an Indianapolis high school. Her imagination was fired by an illustration in Frederick Litchfield's *History of Furniture*. This showed a cabinet in red lacquer with Chinese landscapes in gold and silver, mounted with engraved metal hinges, on a stand carved with a female mask, and decorated on the inside with foliage on a red ground.

Quoting Mr. Litchfield—"Within the last ten to fifteen years there has been in England a greatly increased appreciation of lacquered furniture. Cabinets of the square, boxlike form, having two doors opening and disclosing an interior arrangement of various small doors, now realize five or six times the original amount—the red variety being that which is in most favor. In July, 1920, a cabinet of this description mounted on a Chippendale lacquered stand realized 950 guineas."

One friend of Miss Todd's took a kindly interest in her plans and gave her an old washstand. A furniture repair

man followed her sketches and put the piece in shape to decorate with lacquer in Oriental style. He took off the old drawer and added a straight piece at the back of the top and two small corners below to change the lower line.



FIG. 15.—A Chinese lacquered cabinet in red and gold. The box part is from a discarded washstand.

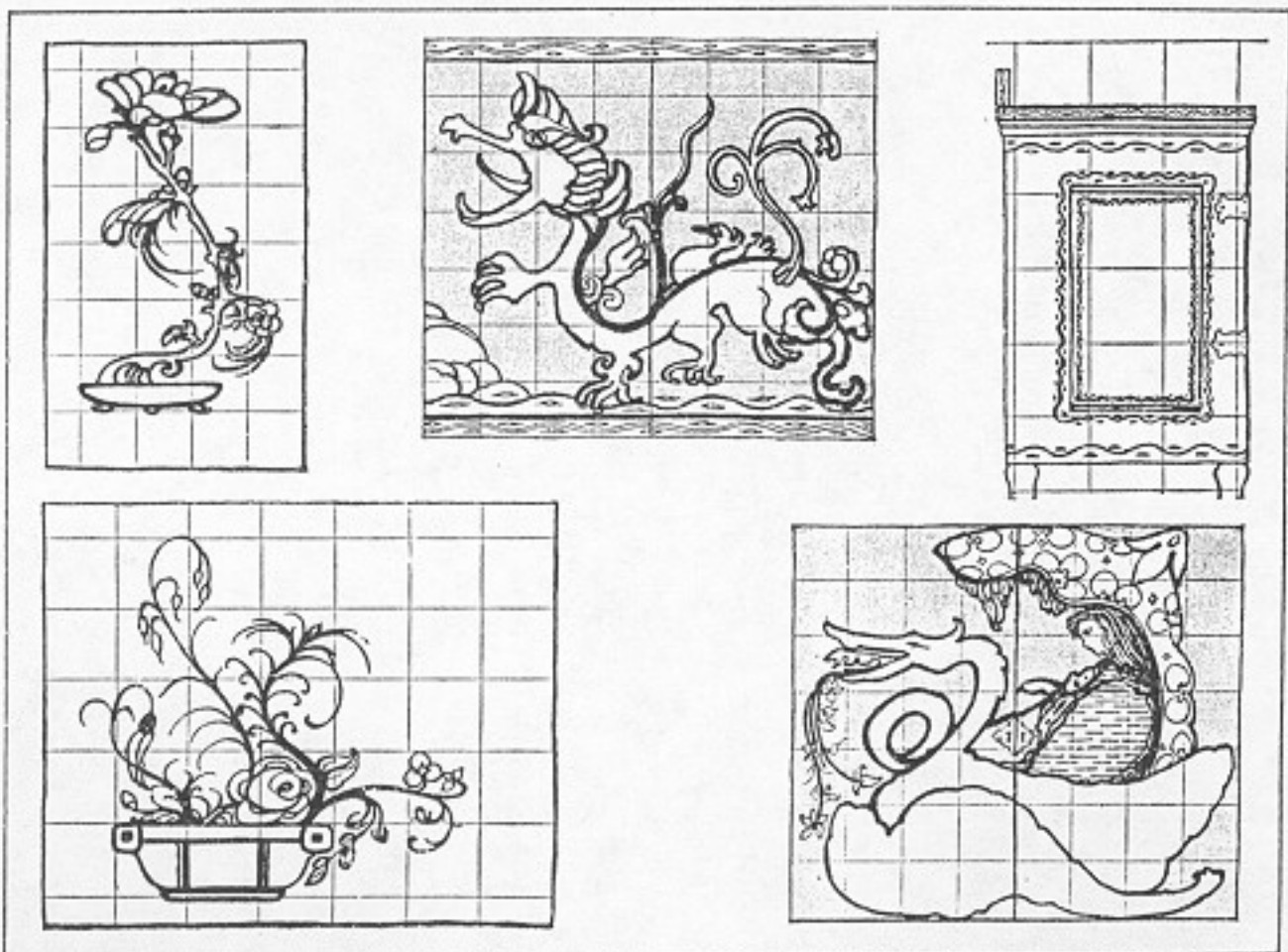


FIG. 16.—Decorations for the cabinet shown in Fig. 15. Above at left: The design used on the inside of the doors. Center: The dragon may be used as an alternative for the design in the lower right-hand corner or combined with that design. Right: The wave and spot design used on the sides of the cabinet. Below at left: The bowl and flower design was applied in black and gold on the back of the cabinet. Right: Design for the front of the doors.

The cabinet was to be used to conceal a small mahogany box phonograph. The repair man placed the phonograph inside the embryo cabinet, after removing the shutter and cover of the box and making a new sounding board. He bored a hole in the back of the cabinet so that the handle for regulating the machine would not be seen. He also made legs and stretchers of gumwood (Fig. 17).

Such a cabinet would house a radio set in regal splendor. It could be adapted equally well to serve as a writing desk by adding a drawer and a slide of wood, or it might be fitted with many little doors and drawers and, perhaps, a secret compartment or two intended for papers, jewels and miscellaneous trinkets.

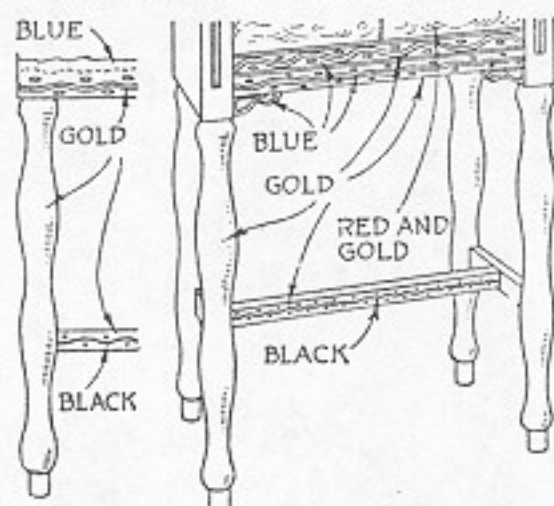


FIG. 17.—The legs were finished in green gold and black lacquers. Note the coloring of the conventional, wave-like borders.

The first step in finishing the cabinet was to use paint and varnish remover on the old walnut, sandpaper the wood thoroughly, and apply a paste wood filler.

Meanwhile Miss Todd had two pairs of brass hinges and a key-lock design about 3 by 3 in. made of brass $\frac{1}{16}$ in. thick. The edges were designed like the notched margins of certain leaves. Her sketch was sent to a brass foundry where such pieces were made. The cost was about three dollars. Later the brass was treated with acid and salt to give an antique effect.

The principal design for ornamenting the cabinet was drawn freehand on paper and then copied on the cabinet (Fig. 15). The basic idea was a dragon guarding the journey of the Spirit of Music and Harmony to the earth. This is shown on squares (Fig. 16) so that you can enlarge it for the two door panels of your own cabinet; or you may use a dragon design, or make an original design.

A claylike material (it can be obtained in artists' supply shops) called gesso was used to raise the design slightly above the wooden background, after a transparent liquid filler or varnish had been applied carefully on the part that was to receive the gesso pattern. There are many ways of making and using gesso: it is essentially a mixture of glue (preferably liquid glue) and whiting with a

little linseed oil and varnish added. The gesso is put on with a patting motion, using the brush full and the gesso about the consistency of medium thick cream.

It is a process that is very simple, but must not be hurried. It is as fascinating as wood carving, but much simpler. The work should be done evenly so that no patching is needed, as that is apt to cause cracks over the surface. If you must add to a spot, let the first coat set overnight. Use a little water to thin your gesso composition. After it hardens, it may be sandpapered with 00 sandpaper, or may even be carved a little with small chisels, but for a less elaborate design this process is not necessary.

In the design illustrated in Fig. 15, the dragon, boat and canopy of flowers are raised a trifle higher than the Spirit of Music part of the motif.

The gesso must be allowed to set for several days; then the design is sandpapered to remove any rough places.

Before painting the surface of the raised design with green gold bronze, several coats of Chinese red lacquer are brushed on the cabinet. For this purpose a high-grade brushing lacquer may be used. Some may prefer a black and gold or a dark green, black, and gold color scheme for their cabinets. Any of these color harmonies are correct from the standpoint of furniture history.

Use a new house-paint brush about 3 in. wide and flow the lacquer on swiftly with an even pressure on the brush. If there should be a slight tendency to ripple, such defects are readily corrected with a second coat, which may be applied within an hour. The following day a third coat is applied.

The next step was the application of green gold to the design itself; that is, to the gesso. The green gold, which comes in powder form, is mixed with an oil medium (this can be obtained in paint



FIG. 18.—The interior of the cabinet, which holds a phonograph, is finished in black Russian lacquer with artistic flower designs in gold.

and art stores of any size) and should be stirred constantly and kept medium thin—a little thicker than water. The gesso surface, though slightly rough, takes gold preparation perfectly if it is applied with an ordinary soft camel's-hair brush, such as is sometimes used for applying washes in water color painting.

After the gold surface is dry, other colors are added for accent or contrasting color harmony. On the cabinet accents of black lacquer and cerulean blue oil paint were used; these softened what might have been a bizarre color effect. From the dragon's head float painted sprays of cerulean blue and gold flowers and leaves.

On the front are painted bands of blue and gold to serve as backgrounds for the borders. The border designs are a line and spot repetition, suggesting waves and foam flecks on water. This is repeated in a 2 in. wide border just below the two door panels and has a cerulean blue background with gold wave and spot pattern. The other smaller borders on the front of the cabinet are blue wave and spots on gold backgrounds. The borders vary in width from $\frac{1}{2}$ to 2 in. They are used on the sides of the cabinet as illustrated.

The 3 in. wide upright strip at the back of the cabinet on top has a gold background, which partly conceals and partly reveals the red lacquer. On this the wave border is painted in black. This treatment is repeated throughout.

Later, to lighten the solid effect of the red lacquer on the front, a few touches of Chinese vermilion oil paint are added; and, after these have dried for several days, an irregular line pattern is applied in gold to suggest the edges of clouds in the red background.

The interior of the cabinet (Fig. 18) is finished in stately black lacquer and gold designs. To the left, beside the

phonograph box, which has been transformed from polished mahogany to a black lacquer finish, there are four upright record compartments made of wood. On the inside of the back is a flower arrangement done in green gold. On the inside panel of each door are tall, slender lily designs in tiny bowls, drawn with free brush lines after the Chinese or Japanese fashion.

If you wish to copy these designs, you may cut paper to the size of the spaces you wish to decorate and, after practicing changing the proportions to suit your space limitations, transfer your design either by chalking the back of the paper or by placing yellow carbon, or impression paper, against the wood and going over your pattern with a medium pencil with a sharp point. The advantage of chalk in transferring the design to a dark background with a high glaze is that it may be readily seen and yet all traces are easily removed when your work is completed.

Last of all two coats of flat varnish are applied. These dry dull and do not require rubbing, although polishing gently with a soft cloth adds to the soft-toned luster.

This cabinet makes a piece of furniture that would grace any living room or studio. If Chinese red is used, care must be taken, of course, in placing paintings or prints near by on the wall, so that they will be subordinate in color to the beauty of the cabinet.

COMBINATION CHEST AND DESK

An unusually interesting piece of furniture, especially for a small apartment, is the combination chest of drawers and desk illustrated in Figs. 23 and 24. What appears to be the top drawer is a well appointed desk when pulled out.

The simple construction brings the

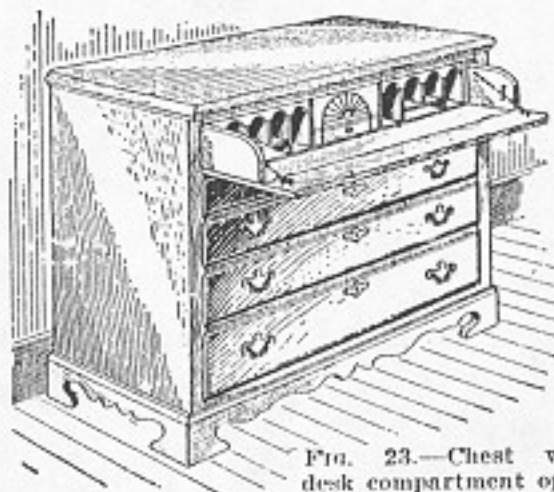


FIG. 23.—Chest with desk compartment open.

project easily within the range of the amateur cabinetmaker. It may be made of birch, maple, oak or mahogany.

Make the ends *a* (Fig. 24) of $\frac{3}{8}$ -in. plywood. Glue and brad in place at both the back and front of *a* the $\frac{7}{8}$ by $\frac{7}{8}$ in. pieces *b*, which are cut to lengths equal-

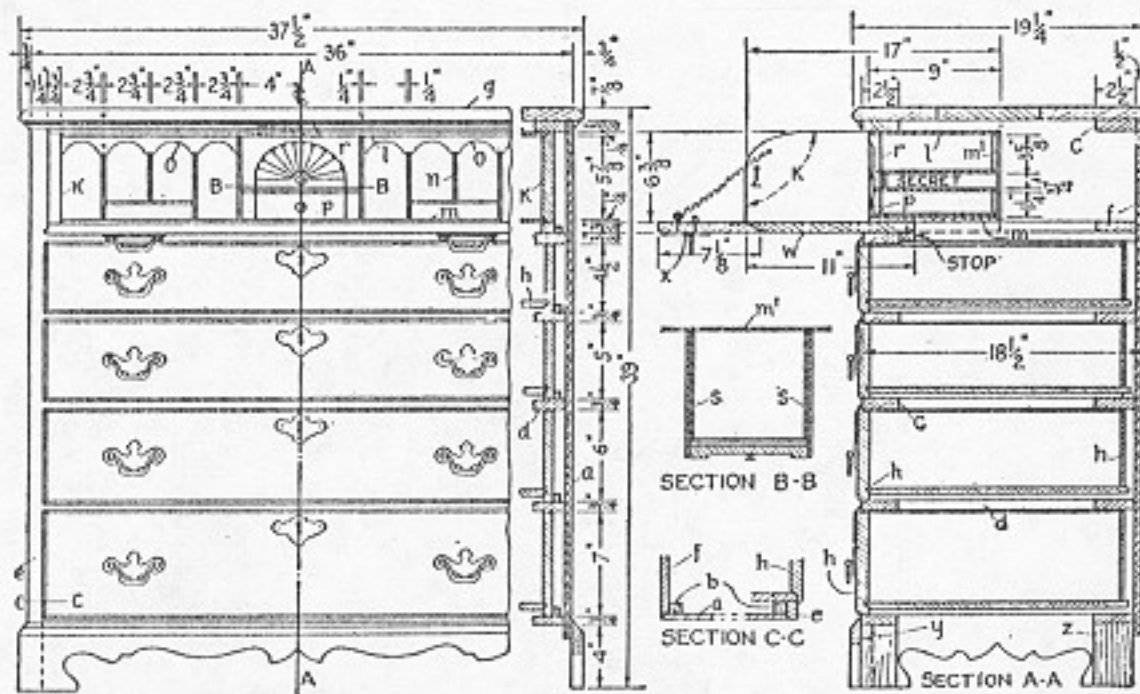


FIG. 24.—Front view of the chest partly broken away to show a section through the end; a sectional view through the center from front to back showing drawers and desk slide.

ing the height of the drawers. Leave $\frac{3}{4}$ -in. spaces between pieces *b* to receive drawer partitions *c* and drawer ledges *d* as indicated. Joint (plane) the front edge of each sidepiece and glue front facings *e* in place. The facings should be $\frac{3}{4}$ by $1\frac{1}{4}$ by $38\frac{1}{8}$ in. and extend to the floor. Two $2\frac{1}{2}$ -in. square blocks or false legs *z* should be fitted to support the back of the case and receive the rear end of the base.

Cut drawer partitions *c*, $\frac{3}{4}$ by $2\frac{1}{2}$ by $35\frac{1}{4}$ in., to fit exactly inside of ends *a*. Place these together and cut all shoulders to fit around facings *e* at once to insure accuracy. Assemble the case, fitting a back *f* of $\frac{1}{2}$ -in. sheathing or plywood. Be sure the case is square. Make top *g* of solid wood, work a thumb molding on the edge, nail it in place, and miter a cavetto (stock cove molding) under it.

Make the drawer fronts, sides, bottoms and backs as indicated at *h*, allowing $\frac{1}{16}$ in. less in length of front to aid in fitting. Make the desk drawer sides *k* $\frac{3}{4}$ by $6\frac{3}{8}$ by 17 in., fit the pigeonhole top *l* and the bottom *m*, $\frac{1}{4}$ by 9 by $32\frac{1}{2}$ in., by means of rabbets into *k*; fit the partitions *n* and the shelves of $\frac{1}{4}$ -in. wood between *l* and *m* and fasten all with brads. Make the arch spandrels *o* $\frac{1}{4}$ in. thick, each of one piece, and fit them with their faces flush with fronts of *l m o*. Fasten the $\frac{1}{4}$ -in. back *m'* in place.

Make lids *w* and *x*; fit and fasten them to *k* as shown. The front of each of the middle drawers *p* and *r* may be made by fitting the sides in front by means of a rabbet and cutting the back between the sides, which should be $\frac{1}{4}$ in. thick; the bottom is bradded to their bottom edges. The $\frac{1}{4}$ -in. sides *s* of the secret compartment support the drawer *r*.

Make the $\frac{5}{8}$ in. thick base, mold the top edge, miter it, draw the design, and have the profile cut by a band saw if

possible. Sandpaper the piece thoroughly and fasten it in place with glue, brads and glue blocks *y*.

Fit broad flap hinges to join *w* and *x*. Fasten a chain support to desk lid *x* and a hook to hold the lid in place when the drawer is closed. Bore holes to receive the drawer pulls and fit the locks and escutcheons.

Sandpaper all surfaces thoroughly. Finish in natural color, or stain if preferred. Give three thin coats of white or orange shellac, rub between coats with No. 4/0 sandpaper, and polish with wax.

TEA TRAY STAND

A tea server (Figs. 25 and 26) is a real asset for the busy housewife during the afternoon tête-à-tête. To construct one requires little skill or expense



FIG. 25.—An easily lifted stand for a tea tray, which can be constructed at small cost.

for materials, especially if whitewood,

redwood, white pine, cypress, or other easily worked woods are used.

The materials required are: 2 sides $\frac{3}{4}$ by $2\frac{1}{2}$ by 32 in.; 2 leg pieces 2 by 4 by 19 in.; 2 pieces $\frac{3}{4}$ by $2\frac{1}{2}$ by 24 in., one for the tray rest and the other for the lower brace; 1 piece $\frac{3}{4}$ by 5 by 26 in. for the handle; 2 pieces $\frac{1}{4}$ by $\frac{5}{8}$ by 12 in. for tray supports; 1 dowel stick $\frac{1}{4}$ by 24 in.; 1 piece cardboard 4 by 10 in.; glue and small brads.

One pattern serves for laying out all the curves. It is drawn upon a piece of cardboard 4 by 10 in., divided into 1-in. squares as shown near the top of Fig. 26. This basic design can be changed as desired to suit the taste of the worker.

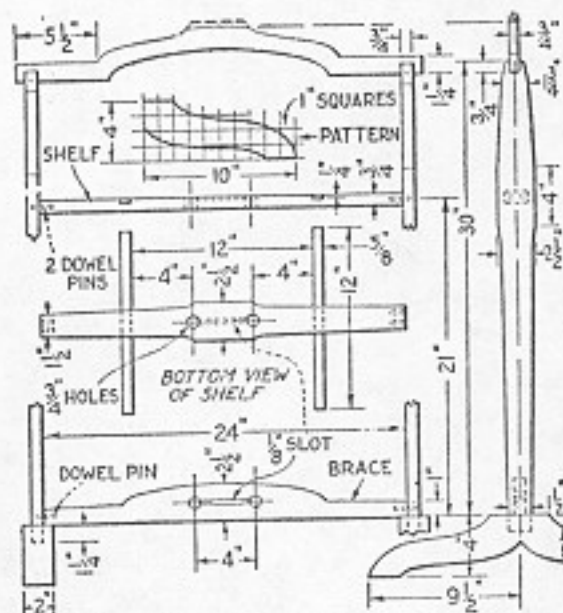


FIG. 26.—Side and end views of the stand, bottom view of shelf, and pattern for laying out the curves.

The quickest and easiest way to cut the curves is with a band saw, but good results may be obtained by using a turning saw. All the edges should be rounded with spokeshave, file, and sandpaper—not a great deal on the ends, but sufficiently on the handle to give an easy grip.

The curved feet receive the ends of the legs, which are tapered to serve as tenons. Glue and toenail the joints with $1\frac{1}{4}$ -in. brads, driven and countersunk from the inside to avoid marring the surface.

Holes $\frac{1}{4}$ in. in diameter are now sunk in the ends of the tray shelf and the lower brace and also in the end pieces to receive dowels. The dowels for the lower brace should be placed so that the lower edge of the brace rests on the flat upper surface of the curved foot pieces. The upper dowels are placed so that the tray shelf is 21 in. from the top edge of the feet. The joints are glued, fastened with small brads, and clamped and tested with a square.

The tray may be purchased from any department store. However, one may design and make his own, using medium heavy picture framing for

the sides and covering the bottom with glass.

Rubber headed tacks are cut so as to have a flat vertical surface and driven in the tray shelf. These bits of rubber press against the tray ends and hold the tray in place. If you do not wish to remove the tray, it may be placed on the support as the finishing varnish is drying. The varnish will hold the tray firmly.

The piece may be stained any desired color, shellacked, rubbed down, and varnished. Either a velvet finish or high gloss varnish may be used. Lacquer, too, will give a beautiful finish, and a stippled effect also would be distinctive. Tassels may be fastened on the legs.

SMALL WELSH DRESSER

Sound, knotty white pine should be used in making a small Welsh dresser like that illustrated in Figs. 27 and 28 so that it will be in strict keeping with

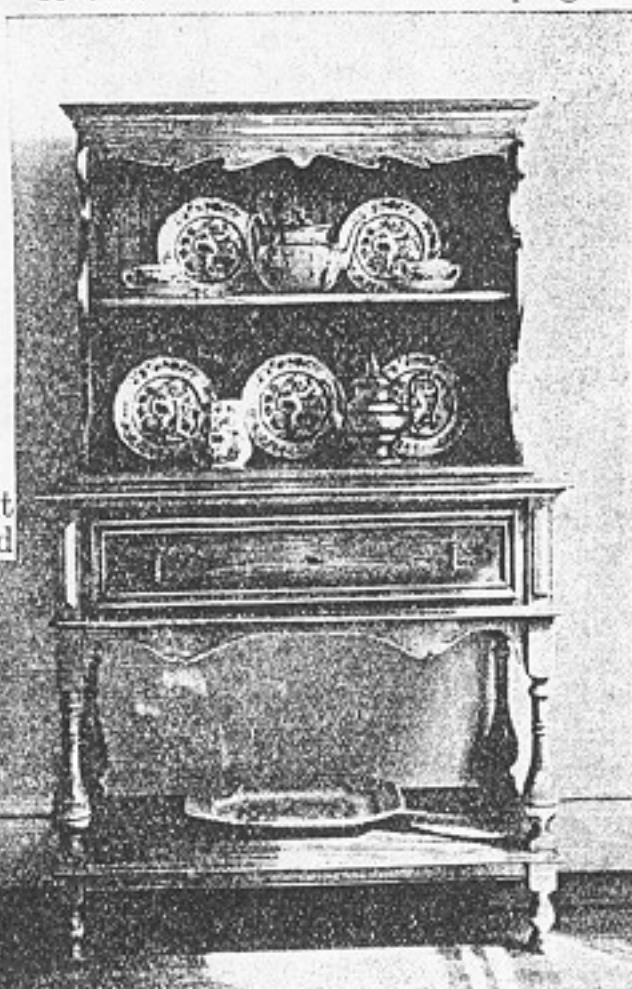


FIG. 27.—Welsh dresser noteworthy for its graceful design and small size. It is made of knotty pine.

original antiques of this type. The original antiques of the small Welsh dresser are highly prized and valuable.

In finishing the dresser an attempt should be made to imitate the mellow tones of fine old pine furniture. This can best be done by applying one coat of boiled linseed oil followed by a coat of one part walnut oil stain to five parts turpentine. Allow the stain to dry thoroughly and then rub the high parts with fine sandpaper until the wood is almost bare, so as to give the piece a worn effect at those places where wear would nat-

urally become visible in the course of years. Follow this treatment with two thin coats of white shellac and a well-rubbed coat of furniture or floor wax.

All the applied moldings shown in the drawings (Fig. 28) are of stock design and can be obtained in most localities, although it is possible to substitute other stock moldings in their places. The drawer pulls should have the finish of dull, antique brass.

The dresser is made in two separate units and these, when completed, are screwed together. The instructions for constructing the two parts of the dresser may be summarized briefly.

Body or base unit. Turn the four legs carefully to the design indicated. Work out the rails to the desired profile and hand dress them thoroughly. Cut all joints and assemble the frame. The bottom shelf must be built in at the same time the project is being glued together.

Construct the drawer and put it in place. Work out the top and fasten it to the frame from the underside by using panel irons or similar fastenings that will allow for expansion and contraction. Apply all moldings.

Shelf unit. Hand dress all the stock. Cut out the profiles of the sides and the top-piece. Cut dado joints in the sides. Carefully fit the shelf, the top, and bottom, and assemble the whole. Fasten the back in place by nailing through into the shelf and the top and bottom pieces.

Apply the top molding. Screw the shelf part to the body part from the underside. Fit and fasten the molding at the junction of the two units. Clean all parts thoroughly with sandpaper and finish as previously suggested.

When a lacquered finish is desired instead of shellac and wax, the following method may be substituted.

Give the wood an antique appearance with greatly thinned brown oak alcohol wood dye or a stain made by dissolving eight tablespoonfuls of air-drying asphaltum varnish in a quart of gasoline. Allow this to dry thoroughly and apply a coat of one part orange shellac and one part denatured alcohol. Smooth this, when dry, with the finest obtainable sandpaper and rub through the stain to form "high lights" as described previously. Dust well and apply another coat of three parts orange shellac to one part alcohol. Finish with two coats of clear lacquer and rub the second with FF pumice stone and crude oil. Finally polish the piece, and the lacquered finish is completed.

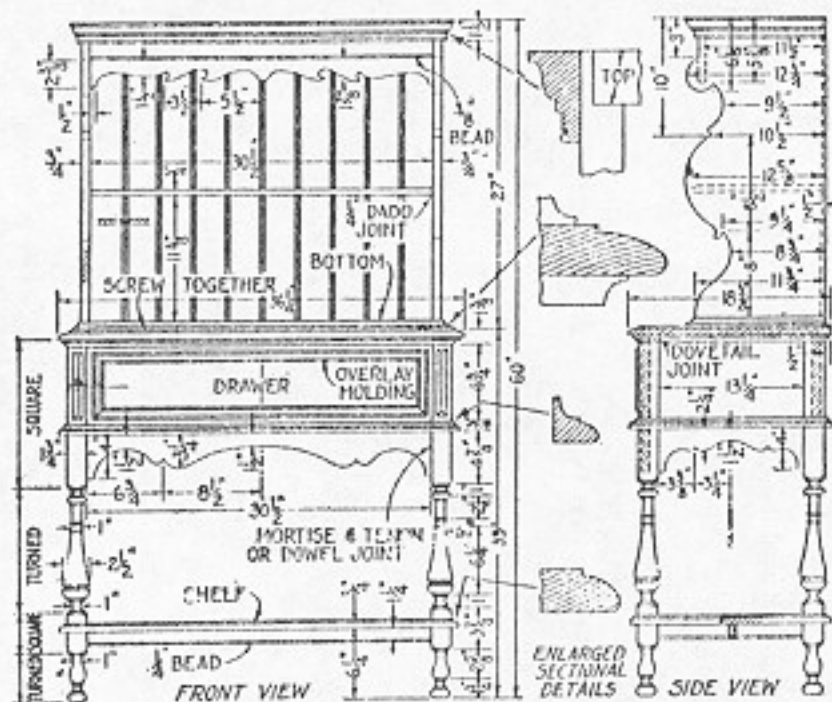


FIG. 28.—Front and side views of the dresser, and details of the moldings. The upper and lower sections are assembled separately.

BETTER HOME WORKSHOP METHODS

A MOMENT of great anticipation! The home mechanic removes the clamps from his assembled radio cabinet and prepares to give it a last cleaning before applying the paint, varnish, or lacquer. What does his inspection show?

Does he mutter under his breath and reach for the plastic wood, putty, glue and sawdust, or powdered-brick crack filler, or does he smile with pleasure as he finds every joint tight and the broad surface free from mars? Much depends on whether or not he has done his work "decently and in order."

By taking thought, any amateur woodworker can do craftsmanlike work. Probably as many mistakes come through improper laying out as through unskillful handling of tools.

Lumber, as it comes to the mechanic these days, is generally of uniform thickness and often flat enough for cabinet building. Nevertheless, in the order of the work, it should be treated as if the sides were not parallel.

One side, usually the better, should be lightly marked with an "X" to identify it as a face side. It is against this side and only this side that the try-square is held for testing the edges. An edge, jointed (planed) straight and square, is likewise taken for a working edge; against this the square is held for marking the ends to be sawed off.

The wise amateur avoids a pencil in laying out. He uses a sharp knife or an awl point. A soft pencil makes a line that is easy to see, but there its virtues end, for a saw wobbling from side to side on it may vary as much as $\frac{1}{16}$ in. A hard pencil is better, but a knife point locates a measurement exactly.



FIG. 1.—Scribing a line along the inner edge of a steel framing square.

When the framing square is used, the marking tool should trace along the inner edge that rests against the wood (Fig. 1) rather than against the outer edge, which does not touch the surface of the wood and therefore allows the point to vary. If carefully sawed along a well-scribed line, the end of the board will be square with the face edge. The other edge may be located either by accurate measurement at the ends—useful especially if it is not to be parallel with the working edge—or by gaging.

Two difficulties beset the man who joints the edge of a board. The plane may scoop out the center, leaving the



FIG. 2.—How to lift a jointer plane at the end of a stroke to prevent "dubbing" or slightly rounding the corner.

ends high; or more commonly, it may reduce the ends while leaving the center.

In the first case, the jointer plane is probably so dull that it chatters at the start, and the user unconsciously confines his efforts to the center, where the plane rides easily. The remedy is to hone the plane iron and take shavings at the ends of the board until the edge is fairly straight, and then to finish with full-length cuts. In the second, the beel of the plane is dropped at the start, and the toe at the end of the stroke, with the result that gradually the ends become "dubbed" off. If the plane is lifted bodily at the end and carried back, a straight edge is more likely to result (Fig. 2). Incidentally, the wear on the plane iron is cut nearly in half.

Accurate measurements depend upon accurate measuring sticks. If the various parts of a cabinet are measured with a square, inaccuracies in reading may

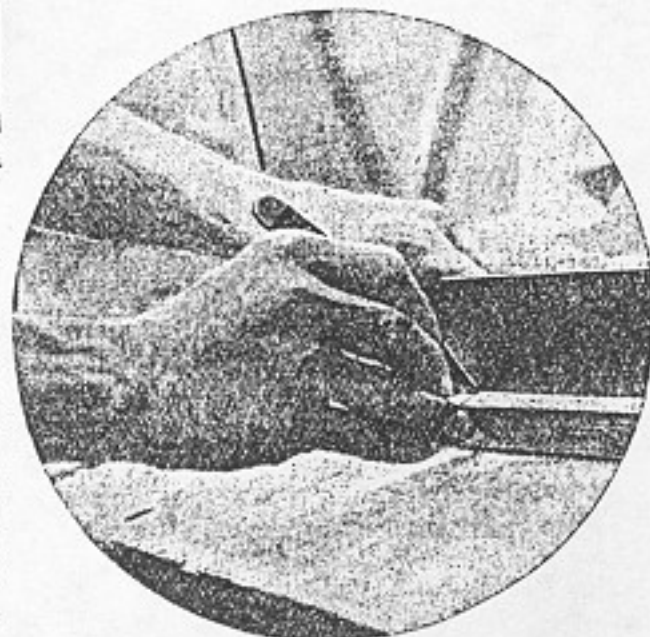


FIG. 3.—Laying out a measuring rod for a piece of furniture with the square held vertically.

cause slight variations in the relative length or width of the mating parts,

making their assembly difficult or even impossible.

In simple cabinets, it is better to lay out one part and take from it the corresponding measurements on other parts. For pieces that are complicated it is best to lay out a rod (Fig. 3); then measurements are made once for all, and the layout is easily transferred from piece to piece.

In making measurements on the rod, stand the square on edge, so that the division lines will meet the surface of the wood. Locate the points with a knife. Score these lines square across the width and label them with a pencil.

An intricate piece, upon which you expect to work for weeks, requires more than a mere stick. For it you should prepare what a cabinetmaker would call a "rod" but what is really a thin board, often as wide as 11 in., upon which a full size sectional plan and an elevation are drawn accurately with a pencil. The edges of the board must be straight and parallel so that a square can be used in drawing the various members.

In sawing, never forget that the blade takes up space. The kerf is usually a little less than $\frac{1}{16}$ in. wide, but is sometimes wider. If the mechanic cuts on the line, he is not sure of the placing, and if the measurement is accurate the pieces will be at least $\frac{1}{32}$ in. undersize.



FIG. 4.—The shoulder of a tenon can be cut more easily if a notch is first made for starting the saw.

For all joints, the proper method is to allow the teeth of one side of the saw to cut the center of the scratch, removing half the line and leaving half on the piece. This keeps the blade in the waste wood, retains a positive working line at all points, and insures a straight cut. If the edge is to be dressed after being sawed, the cut may be made a trifle to the side—enough to allow two or three shavings to be removed before the center of the line is reached.

In starting a side cut for a dado or for the shoulder of a tenon, it is often helpful to cut the starting corner with a knife, notching it in the waste wood (Fig.

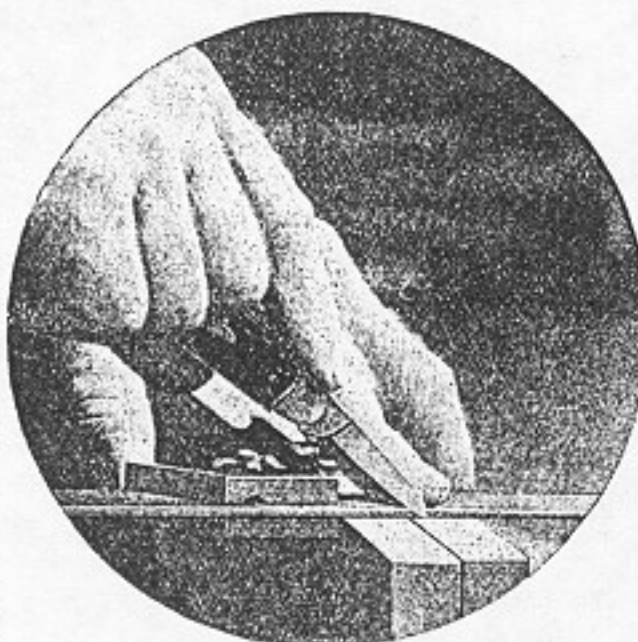


FIG. 5.—Squaring the edges of two boards to locate the position for boring dowel holes.

4). This gives a starting point for the saw and prevents it from dancing around on the surface before biting in.



FIG. 6.—Boring a dowel hole with a block of wood on the bit to serve as an improvised depth gage.

If two boards are doweled together, it is most important that the face edges come smoothly flush. This requires great accuracy in the location of the dowel holes. Clamp the two pieces together, joining edges up, with both face sides out, and square across the edges to locate the holes with reference to the length (Fig. 5). With a gage set to center on the thickness of the wood, scratch across these lines from the face side of each board. As the head of the gage bears against the face sides, any variation from the center on one piece is duplicated on the other. If the boring is true, the faces must be in line when glued up.

Since the grain of the wood will "lead" the bit point, it is well to center-

punch the intersection of the marks with a nail or a nail set so that the bit will start accurately. A bit gage or a wooden block bored to slip over the bit, is a help in boring the holes to a uniform depth and eliminates the danger that some of the dowels will strike and prevent the joint from closing (Fig. 6).

Another precaution: a small amount of space at the bottom of the hole must be allowed for imprisoned excess glue. Glue is no more compressible than water



FIG. 7.—Whenever wood must be hammered, use a soft block of waste wood as a protective cushion.

and is too thick to ooze past the dowel pin; if, then, the clamps are screwed tightly enough, the glue will expand the hole by splitting the wood.

The assembling of cabinet parts often requires them to be tapped with a hammer to force the joints together. Every hammer blow, however light, means a bruise on the wood, unless a block of soft wood is used as a buffer between the hammer and the work (Fig. 7). Blocks should also be used under clamp jaws.

Scratches and mars on the piece seem inevitable, but much ordinary scuffing is avoidable. Only necessary tools should be rested on finished surfaces of the wood. Touch the square gently to the surface; and do not lay a saw on the board at all, for when the tool is picked up again the teeth will surely scratch. Before laying a smoothed side against the bench top or sawhorse, be sure that all shavings, sawdust, and splinters have been swept away.

Most cabinets should be sponged with warm water before the final sanding; this process not only swells flush any small bruises, but raises the grain. When the grain has been sandpapered down again, it will not be affected to any great extent by the application of the stain, which otherwise might raise it badly.

Deep bruises often can be steamed out with the aid of wet blotting paper and a hot flatiron.

HINTS ON DRIVING NAILS

Hammer and nails are in common use in every household. Yet driving nails, the commonest of all mechanical operations, is not often done in such a way as to get the full holding power of the nails. A few plain facts about nails and their uses

mer strikes the nail.

Sometimes an otherwise good hammer seems to slide off the nail. At such a time it will be a good thing to rub the face of it on a piece of fine sandpaper, for it has probably become greasy.

For ordinary use, a bell-faced hammer (one with a convex driving surface) will prove the most satisfactory; it will not mar the surface when the nail is "driven home." The weight of the hammer is partly a matter of choice, although the tendency of the amateur is to try to use a hammer that is too light. From 12 to 16 oz. is the common range, depending upon the required use.

Sharp, decisive blows will produce best results, and confidence on the part of the driver will keep nails from bending.

"Toe-nailing," as shown in Fig. 9, is somewhat more difficult than straight driving. For this it is better whenever possible to start the nails before the pieces are in the final position. Care must be taken not to slant the nails too much or they will not reach the second member properly. This is a common error of the amateur. After some practice one can drive the nails very close in a corner without scarring the wood.

Pulling a nail requires just as much care as driving one. The extra large sup-

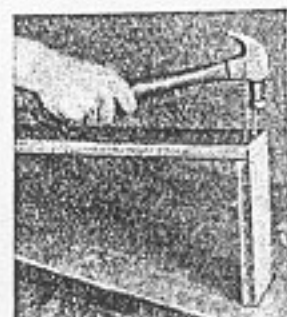


FIG. 8 (left).—Handling a hammer for straight nailing. Note that it is gripped near the end.

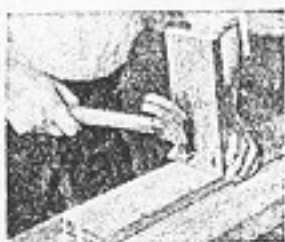


FIG. 9.—"Toe-nailing" (at right) calls for more practice.

would, if they were carefully observed by the amateur woodworker, decrease the difficulties encountered and save much effort and subsequent disappointment in the failure of joints.

The proper way to hold a hammer is the first important thing to learn. The amateur has the natural feeling that the less of the handle he uses, the less likely he is to miss the nail. The truth of this is not borne out in practice, however, for after one has become accustomed to holding the hammer handle at the end, as shown in Fig. 8, he will miss the nail if he tries the former method. It is safe to assume that the manufacturers of any good hammer know something about the best length of handle to use.



FIG. 10.—The proper way to use a hammer when drawing a nail.

The angle of a nail hammer or the "hang" of it will have to be sensed from experience. It will not take long before a person will automatically hold his hammer handle just low enough as the ham-

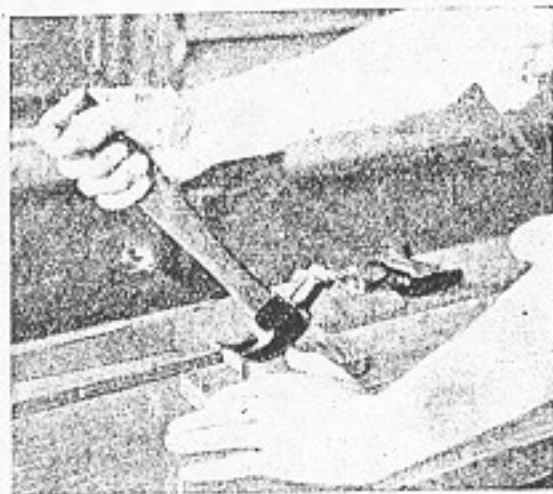


FIG. 11.—A block under the claws of the hammer is necessary in drawing long nails.

ply of hammer handles at the hardware store is kept principally for those who have not learned how to pull nails. The main thing to bear in mind is the necessity of keeping the fulcrum near the nail. This is taken care of by the shape of the hammer when the head of the nail is close to the wood as in Fig. 10. In this way great pulling power is applied by only a few pounds of pull, and the handle is safe.

It is after the nail comes up a distance and the fulcrum shifts toward the face of the hammer that the handle is in danger, both from less mechanical advantage and from the fact that the pull ceases to be vertical. At such a time the wise operator will take time to find a block to put under the hammer as shown

in Fig. 11.

There is a trick in "setting" nails that it takes a little time to develop. Most amateurs make a big ugly hole around the head. Figure 12 shows the proper way to hold the nail set. Steady it with the fingers against the wood so that it will not slip; then make a decisive blow so that the nail goes down below the surface. After that it is easy to drive it as deep as desired without trouble.

In Fig. 13 is shown how to draw pieces into position by the use of nails. The nail is started at an angle from the higher piece, with a crevice left open between the two until the nail has caught the second member. When the

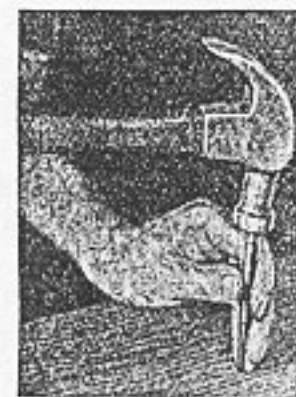


FIG. 12 (left).—How the nail set should be used. The fingers of the left hand prevent it from slipping.



FIG. 13 (right).—Skillful nailing will draw uneven parts into place.

nail is driven in, the joint is closed and the lower piece is drawn up into position.

It is well to bore a hole in the end of the hammer handle with a $\frac{1}{2}$ -in. auger bit and fill it with soap. After dipping the tip of nails into the soap, the driving becomes much easier.

WOOD SCREWS

"What is there to be said about driving wood screws?" the beginner in woodwork is apt to ask. But the old mechanic and those who have studied the results of recent laboratory tests on the holding qualities of screws, know that a good deal can be said.

In all hard woods, two sizes of bits or drills should be used in boring for screws. The larger one should be from 80 to 90 percent of the diameter of the shank of the screw. After some experience, one can gage the size by placing the drill on the shank of the screw as shown in Fig. 14. With this drill, a hole is bored to the depth of the shank or entirely through the first piece of wood if two pieces are to be held together as in Fig. 15.

A smaller bit or drill matched to the size of the root or core of the threaded part, but no larger, is used to bore to the entire depth of the screw. If this is not done the screw will often break before it is fully driven in place. In soft wood, smaller drills can be used and a



FIG. 14.—Placing the bit on the shank of the screw to obtain the correct size before boring.

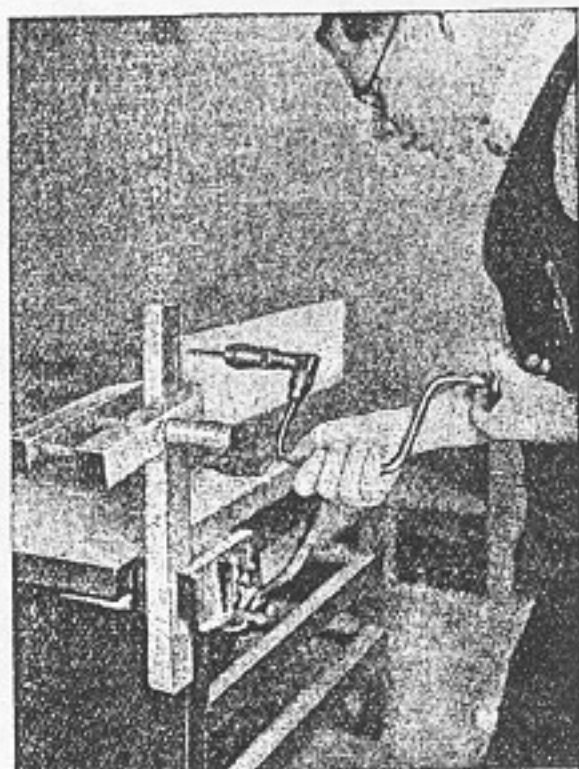


FIG. 15.—Before driving screws, it is of primary importance to know what size holes to bore for them.

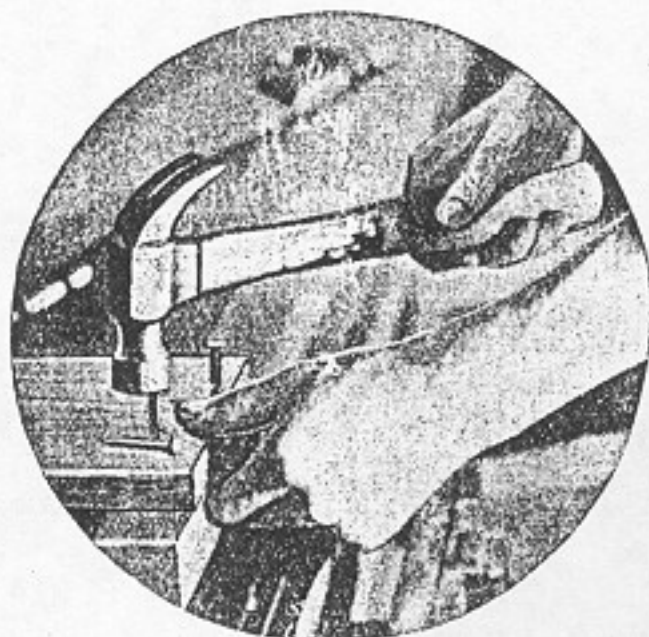


FIG. 16.—Hammering a screw part way in is not as bad practice as is commonly thought.

hole of the same size throughout is often satisfactory.

When an attempt is made to fasten two pieces of wood together without adequate boring, the joint sometimes cannot be pulled tight because the shank of the screw will not slide in the first or uppermost board. In such a case the only remedy is to remove the screws and bore larger holes for their shanks.

A small amount of lubricant, usually soap, placed on the threads of a screw, will make it easier to drive and help prevent breakage. Tests have proved that the holding power of the screw is not appreciably diminished by this practice.

A countersink should always be used to make a seat for flat-headed screws.

To drive screws a part of the way with a hammer, Fig. 16, is not so vicious a practice as some would believe, for scientific tests seem to indicate that the holding power of a screw is slightly increased by being so treated, provided it is not driven too far. The blow of the hammer bends the fibers of the wood downward around the screw and in this position they offer additional resistance.

The use of a screw-driver bit in a brace is shown in Fig. 17. Such a tool facilitates the driving of all larger screws.



FIG. 17.—Using a brace and bit makes easy work of driving a screw.

Care must be taken, however, not to drive the screws too tight, for the mechanical advantage of the brace is great. Other things being equal, longer screws have more holding power than shorter

and heavier ones. Screws inserted in end grain will not hold more than 75 per cent as much as those in the side grain, therefore use longer screws.

HOW TO USE GLUE

In building and repairing, glues play such an important part that we should know more about these sticky substances and how to use them so that the articles made or mended with their aid will hold together under all reasonable conditions of everyday use and even abuse.

Glue has been used for many centuries. Back in the days of the Egyptian pharaohs it was used to build beautiful veneered work. Through the centuries its uses have been multiplied.

Like the earliest glues, the bulk of those made today are from scraps of the hides, the fleshings, and the bones of animals. They are sold in ground, flake, and sheet forms.

Liquid glue usually is made from fish stock, which is washed and cooked in a similar way to animal stock. A very in-



FIG. 18.—Weighing both the dry glue and water is necessary to obtain the best results.

teresting characteristic of glue made from fish stock is that the gelatine or extracted glue does not jell, but remains in a fluid state at ordinary temperatures.

Cheap liquid glue should be avoided, because it gathers moisture. It contains large amounts of salts, such as sodium chloride or common table salt. These salts absorb moisture just as salt on the table will do and on a wet or humid day the glued materials are apt to fall apart.

Good liquid glue has many advantages over other adhesives for use in the home workshop. It is purchased ready for use, so no weighing, soaking, or heating is required. On account of its slow setting quality, the workman is given ample time to get the joints properly together, whereas with hot glue the work must be done quickly before the glue sets or jells. Slow setting also means good penetration of the glue into the wood and added strength. When strength is compared, good liquid glue is as strong as good animal glue.

During the war, glues made from casein were developed rapidly. Casein glues come in dry powder form and are

prepared simply by stirring into cold water. They make a strong, moisture-resisting joint. For glued work exposed to outside weather conditions they have no superior. They are used universally in building airplanes.

There are other so-called glues made from starches, dextrans, and blood albumen, which are used commercially for many purposes.

To obtain the best results with glue in the home workshop, we must have certain equipment. This should include a can of the best quality liquid glue, some high grade cabinet flake glue, a jacketed gluepot, two glue brushes, a cheap dairy thermometer, clamps, and hand screws.

Gluepots can be purchased at any hardware store. The outer vessel is filled with water and heated over a gas-burner or stove. There are more expensive pots heated by electricity.

Good bristle glue brushes with brass ferrules cost from 60 cents to \$1 each, according to size. However, a basswood stick soaked in water for from two to three days and hammered so that the end fibers become separated makes a good substitute. As the end wears away, more of the fibers can be separated. If a brush gets hard, soaking it in water will restore it to its soft condition. The dairy type of thermometer costs about \$1. Carriagemakers' iron clamps and carpenters' hand screws cost from 40 cents up.

The various utensils used with glue should be cleansed carefully and frequently with boiling water. Any small amounts of spoiled glue remaining in the gluepot or on the brushes greatly weaken and sometimes ruin fresh glue.

When liquid glues are set aside after use, the containers ought to be closed tightly. If through evaporation the glue becomes too thick, dilute it slightly with clean, warm water. Do not use vinegar.

Ground, flake and sheet glues should be kept in a clean, dry place, preferably in a tightly covered container of some sort.

In preparing dry animal glues, the glue should be soaked until soft in clean, cold water. It always should be stirred into the water to insure complete soaking. Sheet glues should be allowed to soak at least 12 hours; flake glues, from 4 to 9 hours, according to thickness of the flakes; and ground glues from 2 to 4 hours. It is advisable to let them all soak overnight or prepare them in the morning if they are to be used during the evening.

The amount of water depends upon the grade of glue. The water-taking quality of hide glues varies from $1\frac{1}{2}$ to 3 parts of water to 1 part of glue. Medium grade hide glues take $2\frac{1}{2}$ parts of water to 1 part glue by weight. While bone glues are not recommended for

wood jointing, sometimes they are used and they take only from 1 to $1\frac{1}{2}$ parts of water.



FIG. 19.—A dairy thermometer may be used to avoid accidentally heating animal glue beyond 150° F.

Both hide and bone glues have a wide range of grades, but it pays to use the best glue obtainable.

It always is best to weigh the glue and water each time after the right proportion has been determined (Fig. 18). Glue cannot be prepared by guesswork. Animal glue should not be too thick. It is necessary for glue to penetrate into the articles to be glued in order to bind them together. If too thick, it jells on the surface.

Scales were not mentioned in the list of equipment as they are expensive. Usually a local store will allow you to weigh your glue.

After soaking, the glue should be dissolved in the gluepot. If the soaking is complete, the glue will melt readily. If all the water has not been absorbed, leave it with the glue in the pot. Be sure there is water in the jacket of the pot.

Place the thermometer in the glue and be sure the temperature does not rise above 150° F. (Fig. 19). Glue does

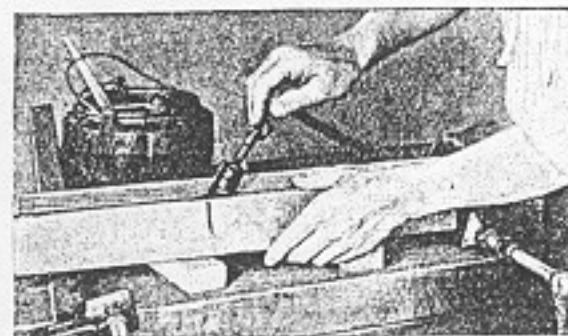


FIG. 20.—Hot glue always should be applied freely to both edges of the wood to be joined.

not have to be "cooked" to make it sticky. Heat is simply to dissolve it and to keep it liquid. When the temperature rises about 160° F., glue rapidly loses strength and if this temperature is continued for some time, the glue is ruined.

Casein glues of good grade usually are

prepared by stirring rapidly 1 part of glue into 2 parts of cold water by weight. Continued mixing is required until all lumps are broken up. The mixture should stand from 15 to 30 minutes for the completion of the chemical action. Only enough glue for the day should be mixed, as these glues become solid like a piece of cheese after about 12 hours.

The preparation of the articles to be glued is important, especially if wood. The joint should be clean and dry. No wood that has not been thoroughly kiln dried should be used with either animal or fish glues. Wood not thoroughly dried can be glued with casein glue.

The wood should be jointed perfectly before applying glue. Uniform contact between the two pieces must be assured. Brush glue on quickly and vigorously and apply it to both parts to be joined (Fig. 20). Then clamp the work tightly so as to force the joint together and allow the glue to dry.

When repairing furniture and other articles that have been glued previously, scrape away all old glue and have the joints perfect again before gluing.

In cold weather it always is well to have the parts warm before applying the glue. Animal glue sets quickly and if it jells before the wood comes together



FIG. 21.—Liquid glue should be brushed on vigorously and all parts of the joint well covered.

firmly, the joint is worthless. When the wood is warm, it retards the "set" and gives the glue a chance to penetrate.

When prepared liquid glue is applied to a joint, it is quite possible to obtain good results by giving one coat of glue to the parts and pressing them together immediately. This is the common way of using liquid glue, but it is not the best way. A little additional pains will insure a very much stronger joint.

First apply a thin coat of liquid glue and allow it to penetrate into the wood. It is not necessary to thin or dilute the glue; simply brush it out thinly. Then apply a second coating and allow the glue to become "tacky" to the finger before pressing the joint together and tightening the clamps, hand screws, wedges, or whatever means of pressure is to be used.

Liquid glue should not be heated except in cold weather when it has become chilled and is too thick. If the glue then is warmed or heated to a temperature not exceeding from 100° to 120° F., it is in no way injured. It is a common custom when liquid glue is purchased in a can to place the container with the chilled glue in a pan of hot water (Fig. 21). It soon becomes liquid enough to apply on any material.

When hot animal glue is used, coat the wood freely on both sides of the joint, press the parts together, and clamp immediately.

When glued wood is placed in the clamps or presses and these are set up (Fig. 22), the surface glue is squeezed into the wood as well as out to the surface of the joint. If the proper pressure is applied, the surplus glue is eliminated—that is, the surplus that is not pressed into the grain of the wood. When a joint is broken, no surplus glue should appear on the broken parts. The glue should be forced into the wood or squeezed out.

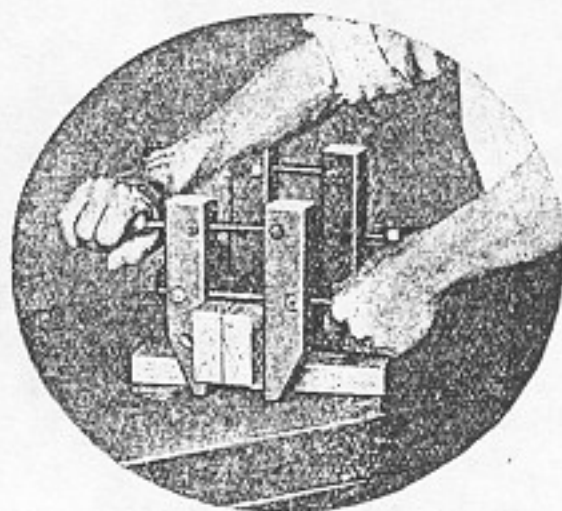


FIG. 22.—In using hand screws, keep the jaws parallel with the wood and use moderate pressure.

Casein glues should be applied to both sides of the joint and clamped. Plenty of time can be taken to do this, as these glues set slowly. It is well to wipe off whatever surplus glue is squeezed out in clamping, as casein glue dries like flint.

In setting up wood in the clamps or hand screws, only enough pressure should be used to bring the two pieces firmly together. Too much pressure squeezes most of the glue out. The wood should be allowed to remain in the clamps 24 hours in a dry place.

There are many other purposes for which glue can be used in the home workshop, such as for sizing different materials to give them body and also to cover a surface so that other materials to be applied will not penetrate. Much liquid glue also is used in the preparation of plastic art clays, often called "gesso."

The preparation of gesso is not difficult. Mix 1 gill of liquid glue, 1¼ cups

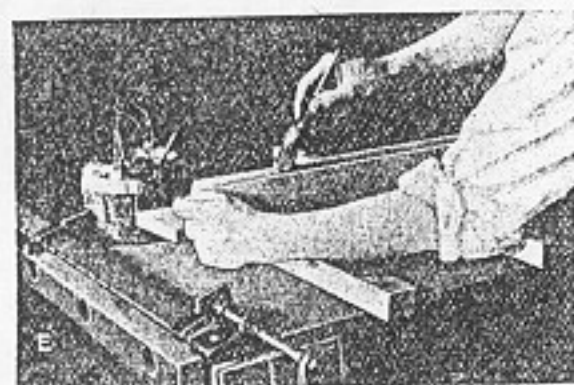
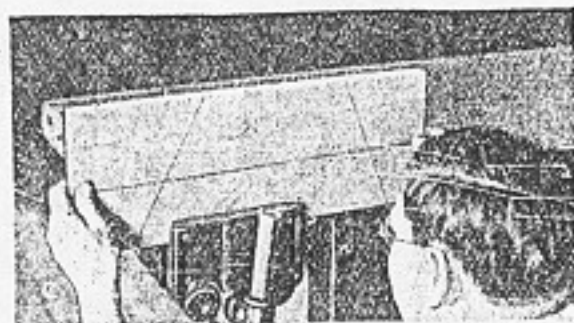


FIG. 23.—How to glue boards together: arranging them, planing, testing for trueness, applying the glue, and clamping.

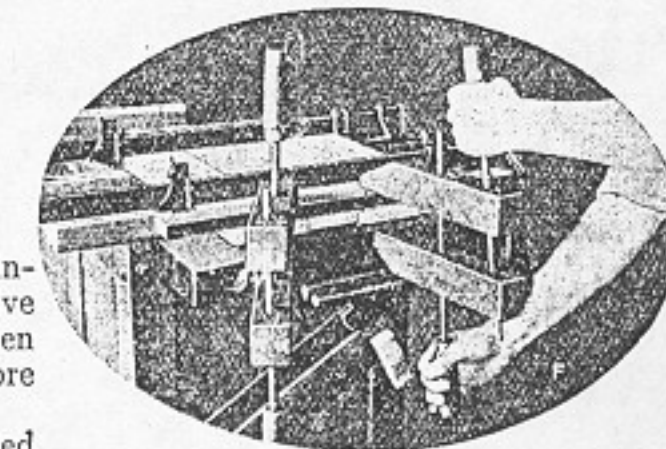
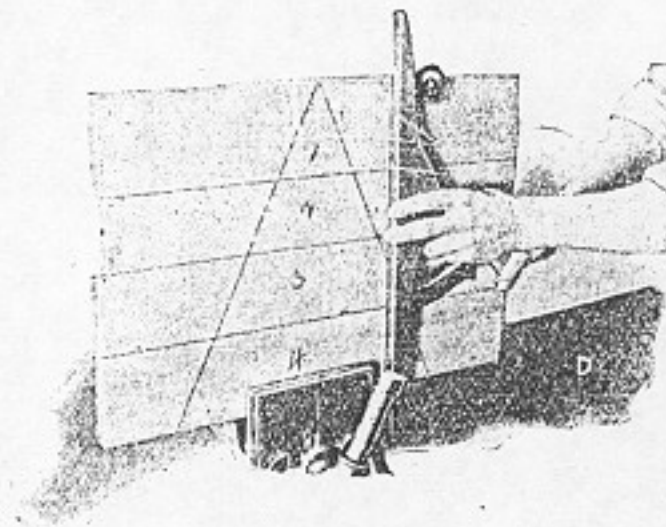
of whiting, and 3 teaspoons each of linseed oil and varnish. These will give about 1 cup of high-grade gesso when mixed. If the paste is too thin, add more whiting.

Gesso is used for plastic or modeled decorations on picture frames, novelties, and furniture. It can be applied with a brush or by means of one of the tools ordinarily used in applying decorative frosting on pastry.

GLUING BOARDS TOGETHER

The first step in gluing boards together to form table tops or wide pieces for other purposes is to arrange them with reference to color and grain. Put the wider pieces toward the edges, if possible. Mark two lines across in V shape, as shown in Fig. 23 at A, and number the boards.

The inside edge of the first board at either side is planed straight and free of "wind" as at B. No squaring is needed as the facing edge is to be planed to the corresponding angle. Have the plane sharp. Note how the jointer plane is held parallel to the edge and how the fingers of the left hand help to keep it steady. When the edge of the next board has been planed, the joint is sighted as at C. At the ends the joint must be absolutely tight and true; the middle may be



slightly open. When each joint has been planed, the whole piece is set up and tested for straightness as at D.

Two pieces are laid across the bench to support the work as at E. Clamps are adjusted for length before glue is applied. If the shop is cold, the joints should be warmed, but not made hot. Use freshly made glue of the best quality. If flake cabinet glue is used, it should be soaked beforehand in cold water. A good grade of liquid glue will serve, but warm the tin in water. Do not clamp too tightly. Level the joints on the face side with a mallet, or a block and a hammer. The glued-up boards are kept straight by the use of wooden cross-pieces and hand screws as at F. These are put on each end of the work. The work is left for about 24 hours so that the joints will dry thoroughly.

PLANING A BOARD ACCURATELY

Surface planing should be done, if possible, with strokes made the whole length of the board, as shown in Fig. 24 at A. If the board is wide, "cross plane" it

first; then start at one edge, letting each shaving partly overlap the previous one until the whole surface is covered. Repeat, working back to the first edge.

Test the surface with the edge of the plane against the light as shown at *B*. Also test from corner to corner to detect twist or "wind." If the board is large, this is done on the bench, using a straight edge, if the plane is not long enough.

Plane the end as at *C*, after one broad surface and one long edge have been planed. The long planed edge is toward the worker. Note that one corner is chiseled off to prevent the wood from splitting. When the edge is planed, the chiseled corner disappears.

Test with the square as shown at *D*. The end must be tested both from the broad surface and the long edge. Hold the handle firmly against the surface and let the square down slowly. The last plane stroke must be right across.

Gage for thickness as at *E*. Hold the marking gage firmly against the wood and tilt the bar forward. Mark both ends and edges. When planing, put the rough end against the bench stop.

Mark to length as shown at *F*. Lay the rule on the surface, locate the knife at the correct point, then move the square up against knife. For accurate work, draw the lines all around the board.

Saw the board $\frac{1}{16}$ in. beyond the knife line as shown at *G*, to allow for truing the end with the plane by the method previously used.

Mark to width as shown at *H* when a board is too wide for the gage.

PLANING A HARDWOOD SURFACE

If you have a glued-up hardwood surface to plane, first support it firmly on the bench against one or two strips thinner than itself as shown at *A*, Fig. 25. It is essential, too, that the bench be absolutely rigid. If your bench happens to give when pushed against, brace it in any convenient way.

Level off diagonally at *B*, and then plane straight with a jointer plane.

Adjust the smooth plane blade and back iron by holding the sharpened iron as shown at *C*, and pushing the cap forward with the thumb until the cutting edge appears no wider than a thread. Hold it in place with the left hand and tighten the screw.

Plane lengthwise with the smooth plane as at *D*. Have the iron exceedingly sharp and adjusted accurately to make the thinnest possible shavings.

Scrape the surface with the grain, but at a slight angle as at *E*. Sharpen the cabinet scraper by the method described and illustrated on pages 411 and 412.

Next sandpaper with No. 1, $\frac{1}{2}$, or 0

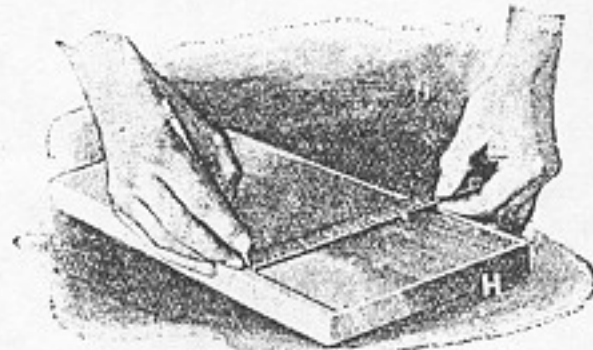
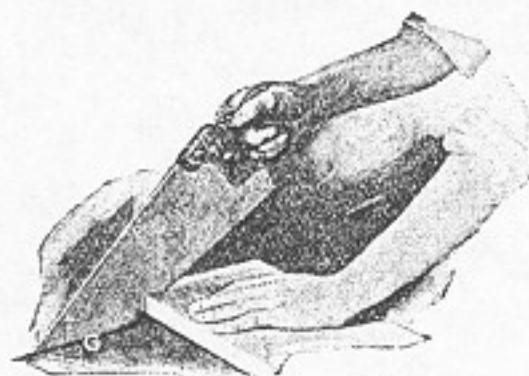
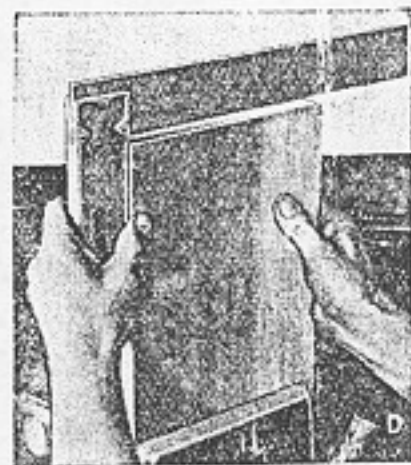
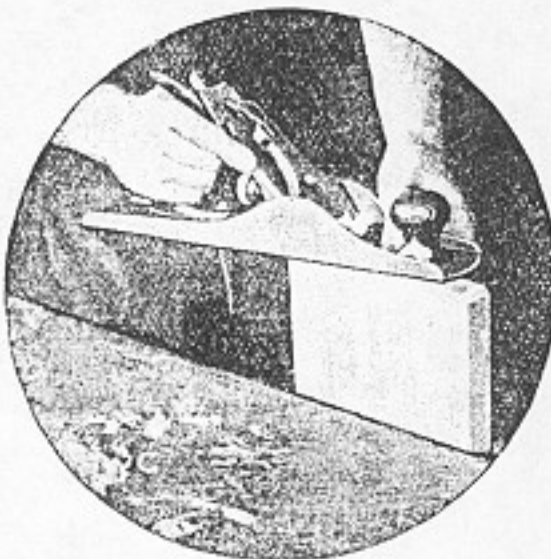
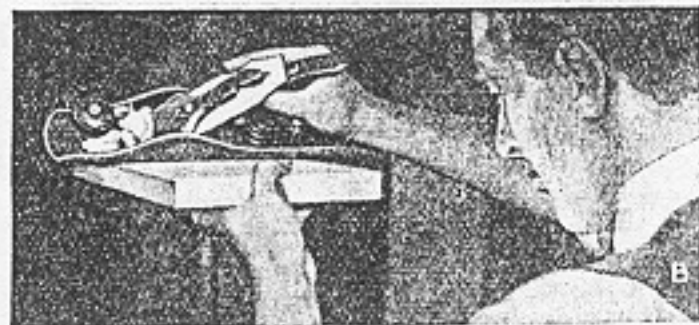


FIG. 24.—Steps in planing a board accurately. Testing the surface and ends for trueness, gaging for thickness, sawing off to length, and marking for width.

paper, depending upon the wood and quality of surface desired. Wrap the paper around a block and make straight strokes back and forth with the grain as at *F*. Crosswise or circular strokes are certain to leave scratches that will later show through the polish.

DOWELED BUTT JOINTS

The doweled butt joint is useful in building screen frames, doors, furniture, and many types of glued woodwork. After the pieces have been squared, the first step is gaging center lines for the

dowel holes. Do the gaging from the face-marked sides as shown in Fig. 26 at *A*. If you are making a table, for example, mark the rails first; then reset the gage for marking the legs.

How to mark the location of the dowel holes is shown at *B*. The corresponding rail and leg are gripped temporarily in the vise and cross lines are scratched on with a knife. Accuracy is the prime consideration at this point if a square, tight-fitting joint is to result.

Marking the centers is shown at *C*. A fine finishing nail is used as a prick punch to make a place for the spur of

the auger bit. If this is not done, the grain of the wood may throw the bit out of line before the spur has taken hold. Another method of marking two pieces is simply to place common pins on one part and press the other part on the first in the correct position.

Boring the dowel holes is illustrated at *D*. A try-square if used when boring serves to test the angle of the auger bit and in a measure indicates the depth of the hole. Note the advance of the chuck along the blade to tell how deep the point of the bit has gone in. Set the table leg at an angle in the vise to allow the knob of the brace to go against your body. Get each hole as nearly perpendicular as possible. In the average work a good depth for the holes is about $1\frac{1}{4}$ in. for 2-in. dowels.

Making the dowels is done as at *E*. If they are not purchased ready-made, the wooden dowels must be made of straight-grained hard wood. Split the rough pieces and plane them as shown or make a wooden block with a triangular groove to support the wood. A dowel plate—a steel plate with holes of various sizes—also may be used.

Testing the joint is shown at *F*. The dowels are cut to length and pointed slightly at the ends. If they fit the holes very tightly, it is well to run the plane over them to make a narrow flat surface, or make a saw kerf their full length. This allows the pocketed air and surplus glue to escape and lessens the chance of the wood's splitting. Use a small brush or a stick slightly less than the dowels in diameter to put glue in the holes. Then insert the dowels in the rails. Glue the joining surfaces, press the parts together, and apply clamps. Test again when the clamps are in place, to see that the clamps have not been so tightened as to distort the joints, which sometimes causes unexpected difficulties.

RABBETED JOINTS

Amateur mechanics who nail and screw together their woodwork without any pretense at joinery are missing half the fun of woodworking. To make a workmanlike joint—even so simple a joint as a plain rabbeted joint—gives real delight.

You will find many uses for rabbeted joints in making furniture, and, indeed, in all sorts of woodwork. Drawer fronts, for instance, are often rabbeted to take the side pieces, instead of being dovetailed. Sometimes this is called an end-lap joint.

After face-marking the pieces, place one member on the other and even at the end and edges, and make a mark in the inner corner as shown in Fig. 27 at *A*. Both pieces, it might be well to remind the beginner, should have care-

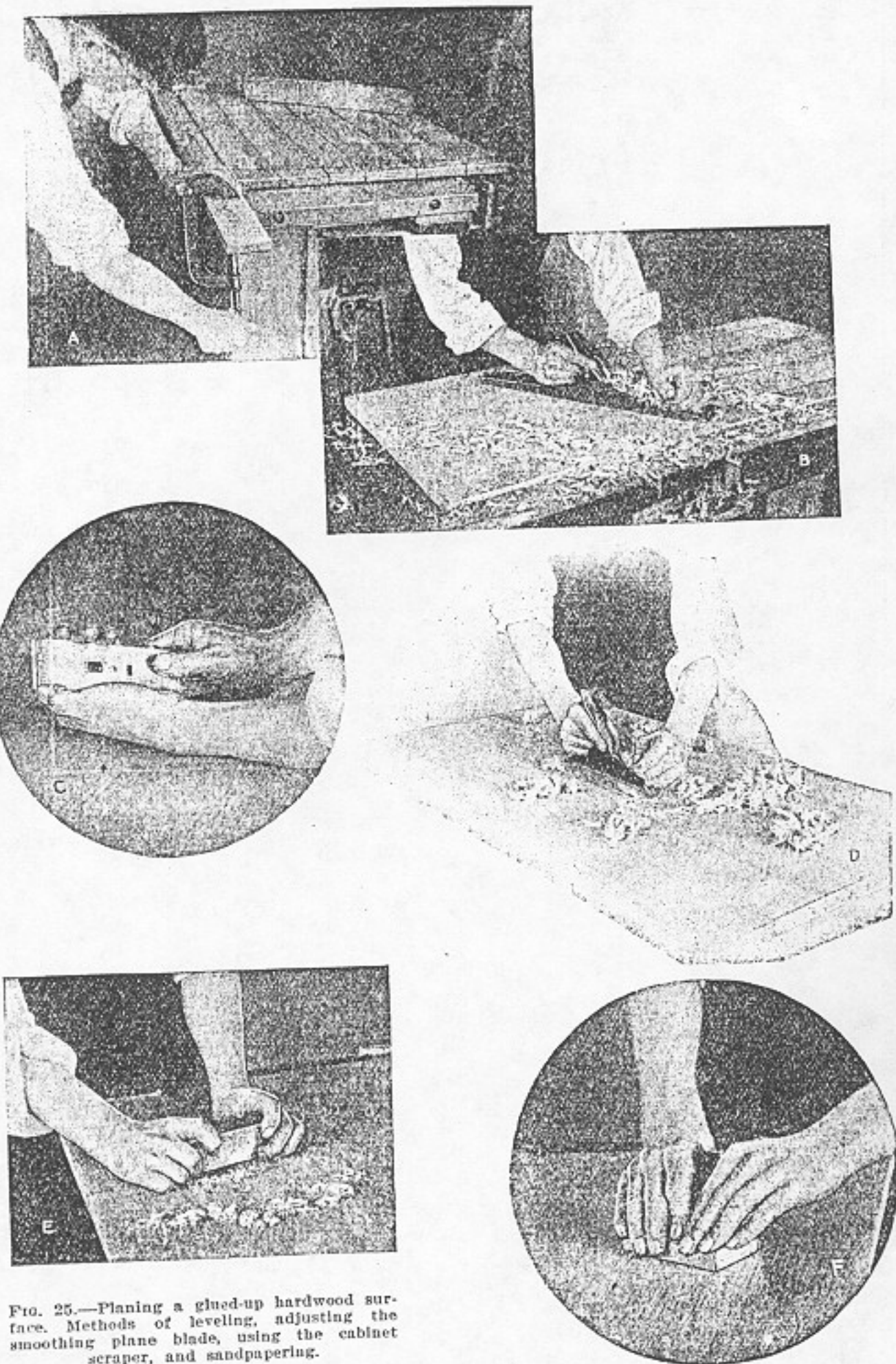


FIG. 25.—Planing a glued-up hardwood surface. Methods of leveling, adjusting the smoothing plane blade, using the cabinet scraper, and sandpapering.

fully squared ends.

Remove the vertical member and place the knife in the mark previously made. Then move a try-square against the knife and draw a line across the surface as at *B*. Continue the line halfway down each edge. On rough work a pencil is used instead of a knife, but it is easier to work accurately to a knife line.

Set a marking gage for whatever amount of end grain is to remain visible in the rabbeted member as at *C*—this may be one half the thickness, but

usually is less. Gage along the end and down to the knife lines along the edges. Place the piece in a vise and cut down on the gage lines with a rip saw, beginning the cut on the nearer corner as at *D*. As you proceed with the cutting, bring the saw level.

Lay the piece flat on a bench hook or fasten it in the vise and cut away the surplus wood with a crosscut or backsaw as at *E*. Beginners usually find it best, and it is always safest, to cut a V-groove with a knife or chisel before

making a saw cut of this kind.

Glue the joint and fasten with plenty of finishing nails or screws as at *F*, at the same time testing for squareness.

MORTISE AND TENON JOINTS

The mortise and tenon joint is universally useful in constructing furniture. To lay out a joint for connecting a table leg and rail, for example, first mark the limits of the mortise, as shown in Fig. 28 at *A*. This length may be two-thirds or three-quarters the width of the rail.

Set a gage to locate the mortise on the leg. When marking the rail as at *B*, use a thin piece of wood as shown to provide for the desired offset. Mark the center of the mortise as a boring guide. Bore holes close together along the mortise, using an auger bit the full size that the finished cut is to be, as at *C*. If no depth gage is at hand, make one from a block of wood. Next clean up the mortise with a wide chisel as at *D*, tapping it with your hand or a mallet. Square up the ends with a chisel of suitable width. Some mechanics cut mortises entirely with a mortise chisel.

Cut the tenon with a fine rip saw (six points or finer) as at *E*, and a backsaw or fine crosscut saw. Mark the width the finished tenon is to be by holding it close to the mortise. Then use a marking gage or simply gage with a pencil held against the thumbnail as at *F*. Remove surplus wood with rip saw and crosscut saw.

The finished joint should fit so that it can be put together by the pressure of the hands as shown at *G*.

CROSS-LAP JOINTS

The first steps in fitting a cross-lap joint, useful for framing or furniture construction, are to square and face-mark the pieces, as shown in Fig. 29 at *A*, and find the middle point of each or the middle point of the joint, if it is not to be central. Through each point square a line with your knife.

Lay one piece on the other as shown at *B*, guiding the upper one against a square. Then remove the square and mark points at each side for the width. Square a line across the wood at the points you have just marked, as at *C*, and also halfway across each edge. Both this step and that shown at *B* must be followed out on both of the pieces. Set your marking gage for approximately one-half the thickness of the wood and mark the edges of both pieces, working from the face side as at *D*.

Either use a backsaw for cutting the joint, first chiseling a V-shaped groove to start the blade, or clamp a piece of wood to the stock as a guide and cut

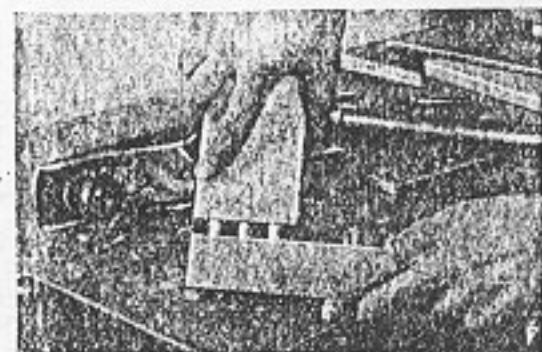
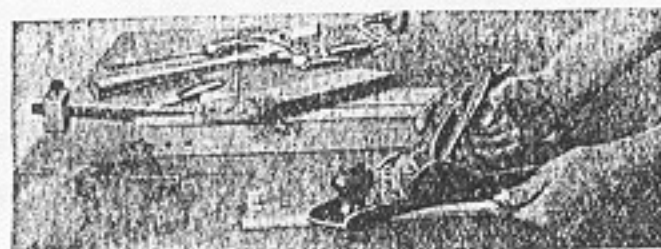
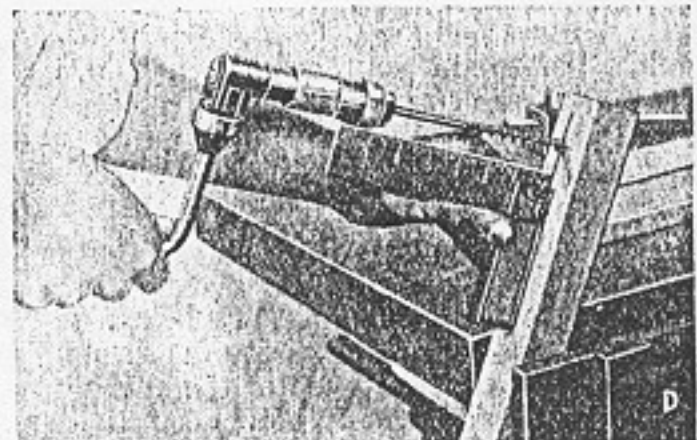
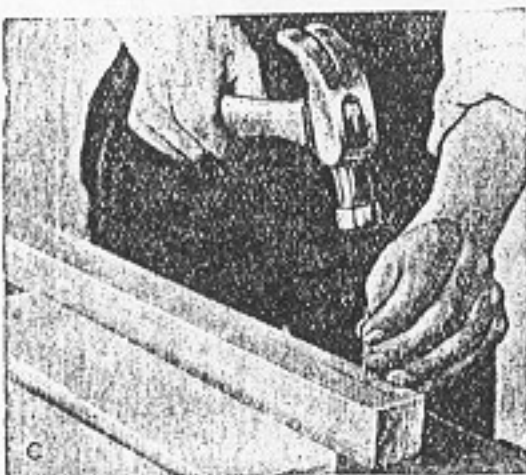
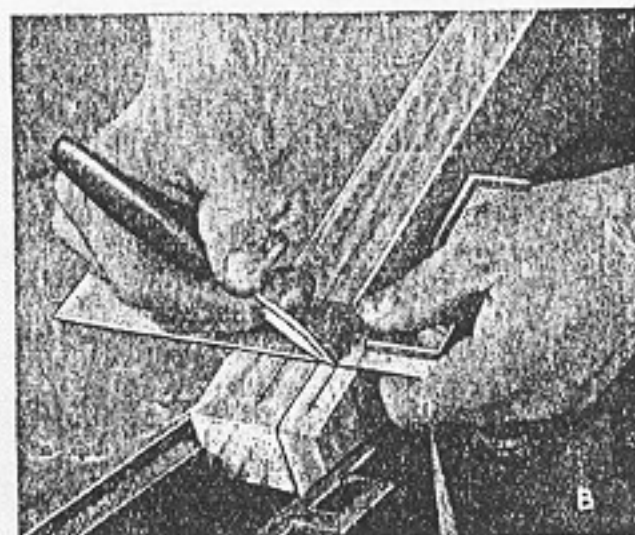
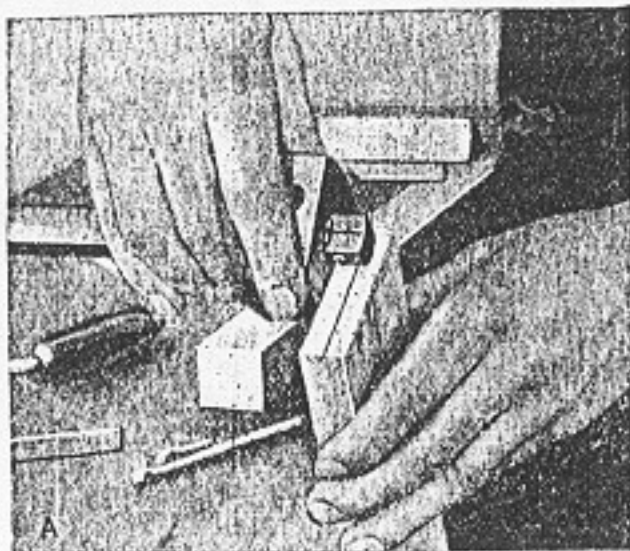


FIG. 26.—How to make dovetail butt joints. Gaging and marking for the dowel holes, boring them, making the dovetails, and testing the joint.

snugly against it with a fine handsaw as at *E*. An expert woodworker does not need this aid, as he can run a fine saw against a knife line by eye with great precision. The saw cut must be accurate so that no trimming will have to be done. Make a cut or two in the waste wood to aid in chiseling. Hold the work with a waste piece behind it as shown at *F* and use as wide a chisel as possible to remove the waste wood.

The finished joint shown at *G* should go together without forcing. The joint may be laid out in other ways, but this is a safe, easy method for beginners.

DADO JOINTS

The dado is a useful joint for door and window frames, shelving and furniture. After the boards are planed to dimensions, square a knife line across one of them at a distance from the end equal to the thickness of the stock plus the

desired extension as shown in Fig. 30 at *A*. This line marks the inner cut for the dado.

Place the second board on the first one, mark the width of the stock and square a second line across as at *B*. Then carefully mark the depth of the dado with a gage.

Unless you are an expert with the saw, it is advisable first to make a V-groove for starting the saw as at *C*. This insures a clean and very accurate cut. Use a backsaw or any fine handsaw. Start the cut on the farther side and gradually lower the saw to a horizontal position as at *D*. Cut exactly to the depth of the gage lines on both edges.

Remove the waste wood with as wide a chisel as possible, working first with the bevel down and then with the bevel up as at *E*. Test the bottom of the dado with a square.

If the dado is made accurately, the parts should fit without play when

pressed firmly together as at *F*. The joint may be fastened with glue or nails, or both. It must be very accurately fitted if glue alone is to be used.

DOVETAIL JOINTS

If you will pull out one of the drawers of almost any well-built piece of furniture, you will find the front and sides are fastened together with a multiple dovetail joint—the aristocrat of wood joints. This is at once one of the strongest and neatest of fastenings at the command of a cabinetmaker.

It can be made in three principal forms—the half, half-blind, lapped or stopped dovetail, as at the front corners of a drawer; the through dovetail, as in fine boxes, chests and cases and sometimes at the back corners of drawers; and the mitered or secret dovetail, which outwardly looks the same as a mitered joint.

There are many ways of making dovetail joints. The experienced mechanic often lays out the tails by eye. He takes care, if doing fine work, to make the pins much narrower than the tails. This distinguishes a handmade dovetail from the much commoner machine dovetail, in which pins and tails are the same width.

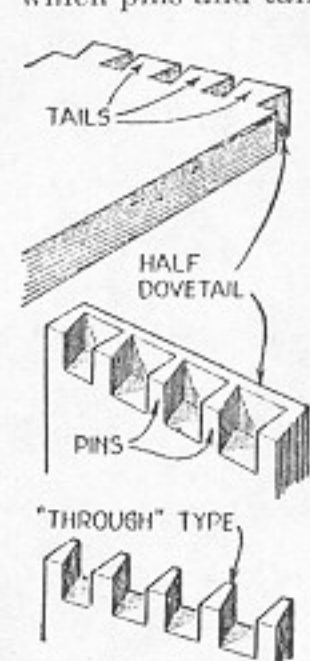


FIG. 32.—The two members of a "half" or "lapped" dovetail, and one member of a "through" dovetail.

Cutting the tails with a fine back- or dovetail saw is shown at *D*. Several pieces at a time can be cut.

Remove the waste wood with a chisel as at *E*. Work from both sides and split the lines with great care.

Transfer the exact shape of the tails to the front member by holding the pieces in position and marking with a knife as at *F*. Continue the lines on the inside down to the cross line, which was drawn with the square and knife. Saw down on the lines at an angle as



FIG. 27.—Rabbeted joints. How to measure and mark the width and depth of the rabbet, saw out the surplus wood, and nail the boards together.

shown at *G*; the wood between the pins then can be carefully removed with a chisel.

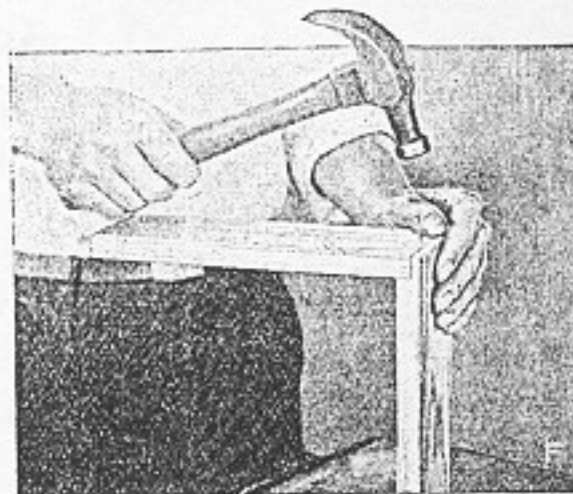
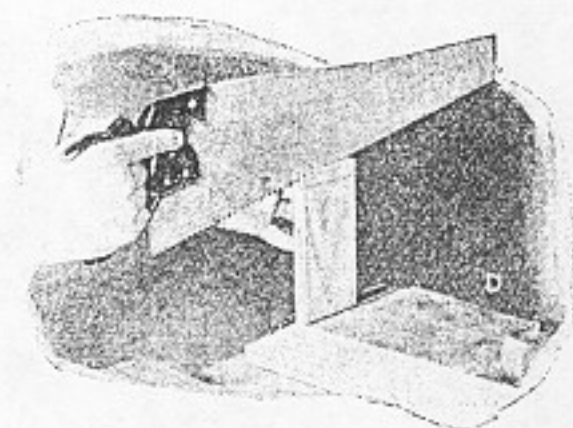
Properly made, the joint may be pressed together by hand as shown at *H*. Apply a little glue before assembling.

Substantially the same process can be followed in making a through dovetail joint, except for the preliminary laying out. Figure 32 shows the difference between the two types.

The gaged line at the end of the drawer front referred to previously may be from $\frac{1}{8}$ to $\frac{1}{4}$ in. in from the front face. This lap is shown in the middle of the three drawings of Fig. 32; compare with *A*, *B*, and *F*, Fig. 31.

HOW TO DO INLAYING

Inlaying is often regarded by the amateur craftsman as a difficult process. This is because he has never seen how inlaying is done and, therefore, does not realize how comparatively simple and easy the process really is.



While inlaying is quite easy to do, it is a process that does not lend itself readily to machine production. Inlaid pieces of furniture command a good price by virtue of the handwork lavished upon them, while the painted imitations and plain pieces sell for very much less.

The home woodworker, who is interested and ambitious enough to experiment a little with inlaying, will be amply repaid for his trouble through the satisfaction he will experience in being able to make furniture not only of greater beauty and distinction, but also of greater intrinsic value—a value that can be measured directly in dollars and cents.

Inlay in general is made in two forms, lines or bands of varying widths and patterns, and inserts of a multitude of shapes and designs. This material is made by specialists. The lines are in pieces one yard long and vary in price from less than a cent to about twelve cents a yard. The inserts are sold by

the piece; those described in this article cost from 50 cents or less to \$1 each.

When lines are to be inlaid, a groove must first be cut in the wood of exactly the same width as the line and of a depth about equal to the thickness of the line. The tool for cutting such a groove (Fig. 33) can easily be made of an old hack saw blade or similar piece of thin steel. It is ground down on an emery wheel to approximately the right width, after which it is sharpened on one side only like a chisel. The more carefully



FIG. 33.—Cutting grooves for inlays with a modified marking gage which has a cutter instead of a point.

this sharpening is done the better it will cut. The spur is removed from an ordinary marking gage and this piece of steel inserted in its place (Fig. 34).

A groove is then cut with this tool, and if it is too wide the cutter is ground down. For the best results the groove should be so narrow that the inlay must be forced gently in place. This tool will

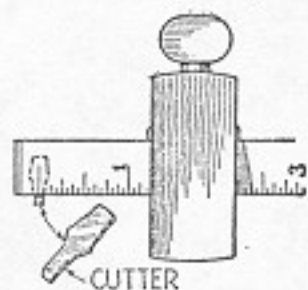


FIG. 34.—Tool for cutting grooves made from common marking gage.

cut grooves across the grain, but corners and awkward places generally must be cut and cleaned up with a pocketknife and a $\frac{1}{16}$ -in. chisel (sometimes ground down to $\frac{1}{32}$ in., depending on the width of the in-

lay). It is recommended to make a cutter for the plain satin lines, $\frac{1}{16}$ in. wide. For wider lines, two or more cuts can be made with this cutter until the desired width is obtained.

When the grooves have all been cut and the corners cleaned, the lines are cut to length and mitered in the corners. Thin glue is then run into the grooves and the inlay forced in place

with the aid of a hammer. The surplus glue should be wiped off with hot water and the inlaid piece allowed to dry overnight. If an insert is to be used in the center, as on the serving tray shown in Fig. 35, it may be glued

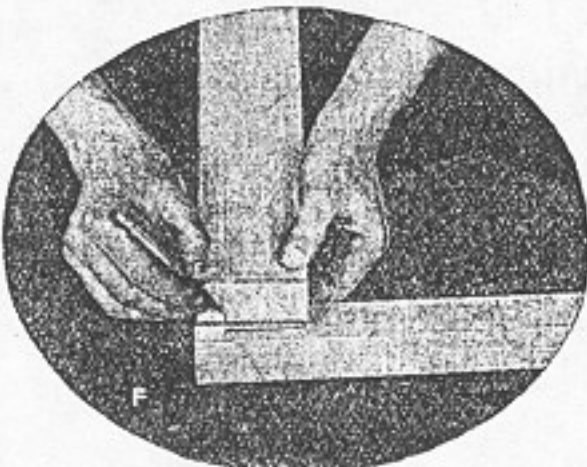
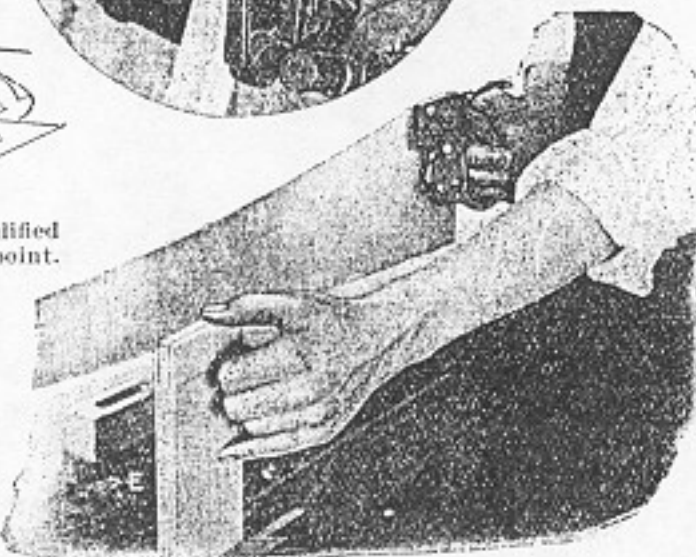
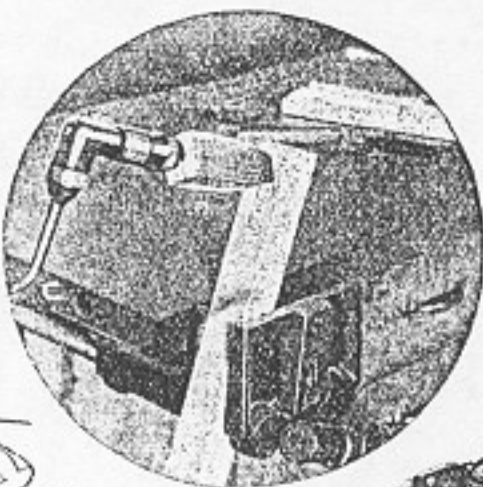
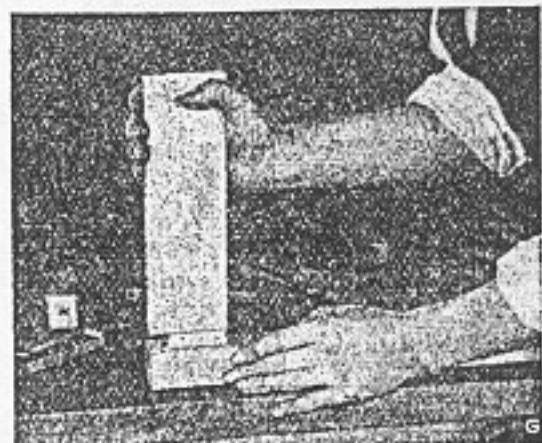


FIG. 28.—Steps in making a mortise and tenon joint. How to gage and mark the mortise and tenon in the leg and rail of a table; using the auger bit and chisel to make the mortise, and the rip saw to cut the tenon; pressing the finished joint together.

in place at the same time.

Inserts sold by manufacturers of marquetry are always glued to a piece of brown wrapping paper and set in a piece of mahogany veneer. This surplus veneer around the edges is first cut away with a knife. The insert is then placed face down in the exact center of the tray, and a fine line marked around it with a sharp pencil. Draw perpendicular center lines

both on the tray and the insert. If the insert is of an oval or circular shape, the outline is cut down with a sharp penknife, after which the wood in the center is cut away with a router plane. Set the plane to cut only a thin shaving at a time until the desired depth (equal to the thickness of the insert) has been reached. If the work has been carefully done, the insert should fit in the recess that has been cut. It is glued in place face down, with the



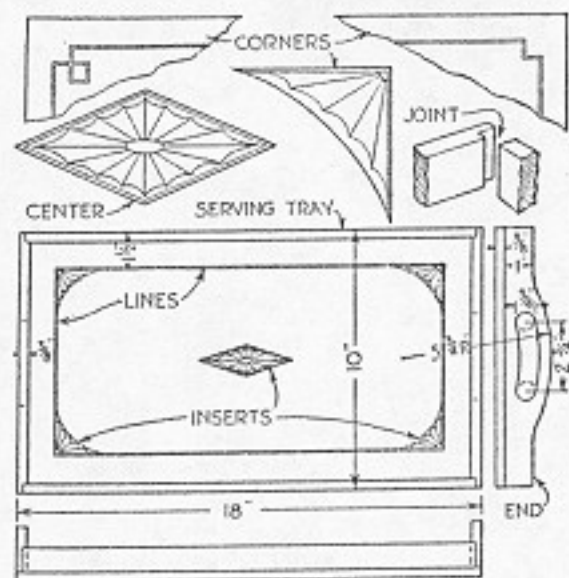


FIG. 35.—Tray with border lines and corner and center inserts; note alternative designs for the corners.

brown paper on top, and is held in place by a weight. When it has dried overnight, it is scraped with a cabinet or

veneer scraper. This removes the brown paper and brings out the pattern of the inlay. The corner inserts are inlaid after the line inlay has dried.

A serving tray such as illustrated in Fig. 35 is a serviceable as well as beautiful addition to the furnishings of the dining room. Before beginning work on it, however, it is well to ascertain if the dimensions given are suitable for the stand or tea wagon on which it is to be placed.

Its construction is very simple. The bottom is made and inlaid as described above. The frame consists of four pieces put together with a rabbetted joint at the corners, as shown. The opening to form the handle is carefully laid out on one piece, after which the two end pieces are clamped together and a number of holes are bored through them with a $\frac{3}{4}$ -in. auger bit. The bits of wood left between these holes are cut away with a chisel and smoothed with scraper, file and sandpaper. It is better to cut these holes before cutting the outside shape and

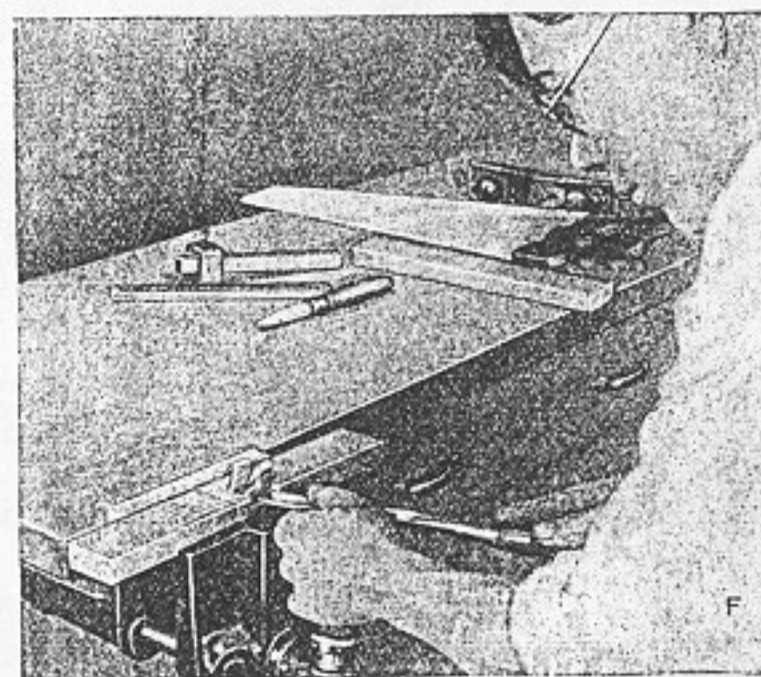
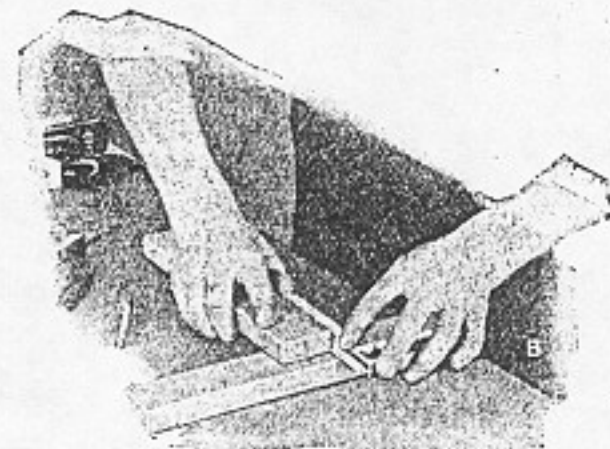
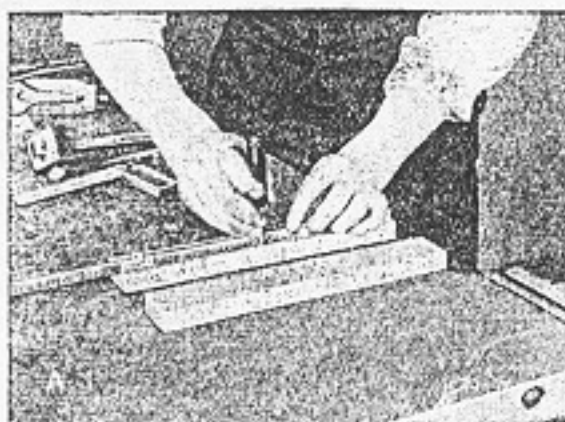


FIG. 29.—Illustrating a good method of making a cross-lap joint. Squaring and face-marking the pieces, gaging and marking the depth of the lap with a gage, making the saw cuts to the knife lines, chiseling out the waste wood, and lapping the joint together.

making the joints, because there is less danger of splitting.

The frame is glued together, smoothed and sanded, after which it is either glued or screwed to the bottom. The writer has found gluing the easier, if enough hand screws are available. It is not recommended to use a glass plate over the bottom, because dust will collect under the glass in time and make it unsightly, and if any liquid is spilled it is likely to run under the glass. If the tray is finished with linseed oil it will not be marred

easily even if something is spilled on it.

The mirror shown in Fig. 36 is suitable for a hall, a parlor, or a bedroom. The four pieces forming the frame are first squared to dimensions, after which the rabbets are cut for the glass. They

MATERIALS FOR TRAY, FRAME,
AND TEA TABLE

No.	Pcs.	T.	W.	L.	Part
<i>Serving Tray</i>					
1	3/4	10	18	Bottom	
2	3/4	1	17 1/2	Sides	
2	3/4	1 1/4	10	Ends	
2 yds.				Inlay	
1				Center insert	
4				Corner inserts	
<i>Mirror Frame</i>					
2	1	2 3/4	25 3/4	Sides	
1	1	3 1/2	10 1/2	Top	
1	1	4 3/4	10 1/2	Bottom	
1	3/4	4 3/4	16	Top	
1	3/4	1 1/2	17	Bottom	
1	3/4	1 1/4	19	Molding	
1	3/4	12	19	Backing	
2	3/16	1 1/2		Rosettes (turned)	
2				Inserts	
5 yds.				Inlay	
1	1/4	11 3/4	18 3/4	Plate glass	
<i>Tea Table</i>					
2	1 1/4	1 1/4	30 1/2	Frame	
2	1 1/4	1 1/4	8	"	
1	1 1/4	1 1/4	18 1/2	"	
4	1 1/4	5	8 1/2	"	
1	1	3 3/4	29	Lower brace	
1	1	2	29	Upper "	
1	1/2	18	24	Tray	
1	3/4	3/4	78	Molding	
2 yds.				Inlay	
1				Insert	
2		3/4	1 1/2	Hinges	
1				Catch	

All dimensions are in inches except where otherwise specified.

are then joined in the corners with dowels as shown, glued, smoothed and sanded.

The grooves for the inlay are cut with the marking gage, the head bearing against the outside edges of the wood. The insert is glued in place as described above, after which the whole frame is scraped and smoothed. A small bead as indicated in Fig. 36 may be cut with an ordinary marking gage on the inside edges of the frame after

it has been glued together.

The top piece is glued to the top of the frame after the insert and the turned rosettes have been glued in place. The joint is covered by a piece of molding, which can either be bought ready made or worked out with a gouge, scraper and sandpaper.

The backing should be of soft pine or

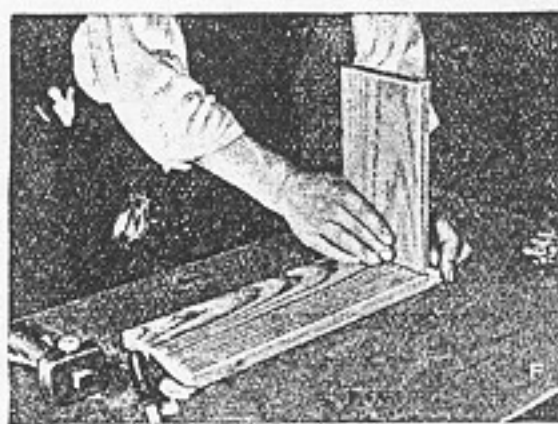
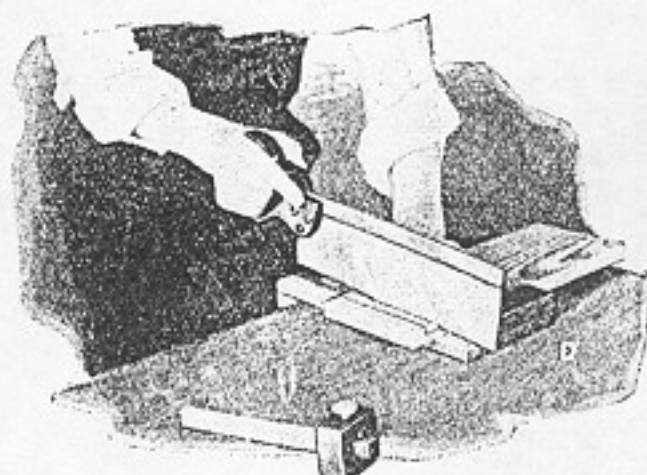
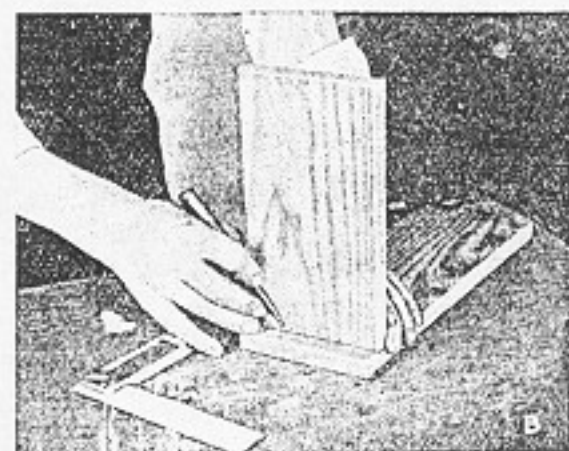


FIG. 30.—Steps in making a dado joint. Marking the inner cut for the dado and the width of the stock; making a V-groove for starting the saw; sawing to the gage lines, removing the waste wood with a chisel, and testing the joint.

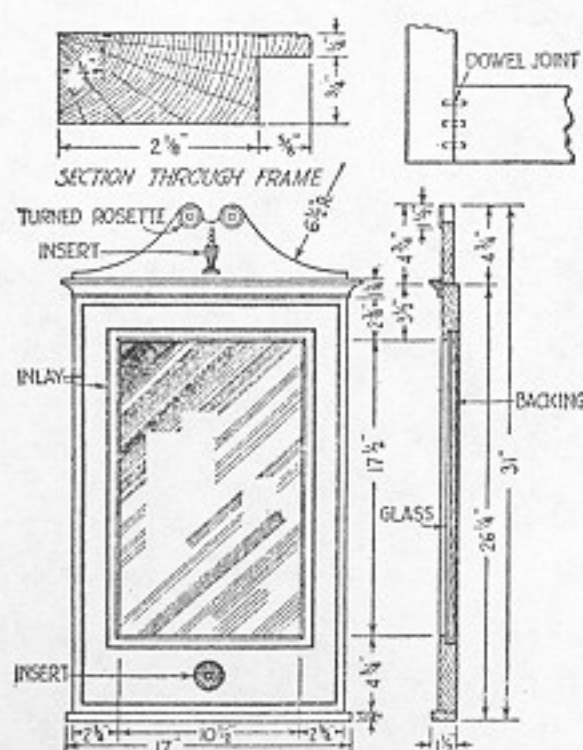


FIG. 36.—A mirror of rare charm with inlaid lines, decorative inserts, and rosettes.

whitewood and nailed in place. It is a good plan to place several layers of paper between the glass and the backing.

The tea table shown in Fig. 37 is a piece of furniture that is a little out of the ordinary. It consists of a tray hinged to a frame.

The frame is very simple of construction, consisting of five pieces joined by doweled joints. The vertical sides each have two shaped pieces of the same thickness as the frame glued to them. These pieces may be beaded on the edges as shown by first gaging the beads with a marking gage and then slightly rounding them with chisel, scraper, and sandpaper.

The two sides of the frame are joined with the shaped stretcher at the bottom, which is mortised into them and glued in place. The piece to which the tray is hinged is glued and screwed to the frame.

The tray, which is 1/2 in. thick, is in-

laid as shown, after which a molding is fitted and glued in place flush with the edges. It is hinged to the crosspiece in such a way that when it is in the horizontal position it projects an equal amount on each side of the frame. The hinges should work rather stiffly so that the tray will not tip when placed in the vertical position. When used for serving tea (in the horizontal position), it is prevented from tipping by a catch, which locks it securely to the crosspiece.

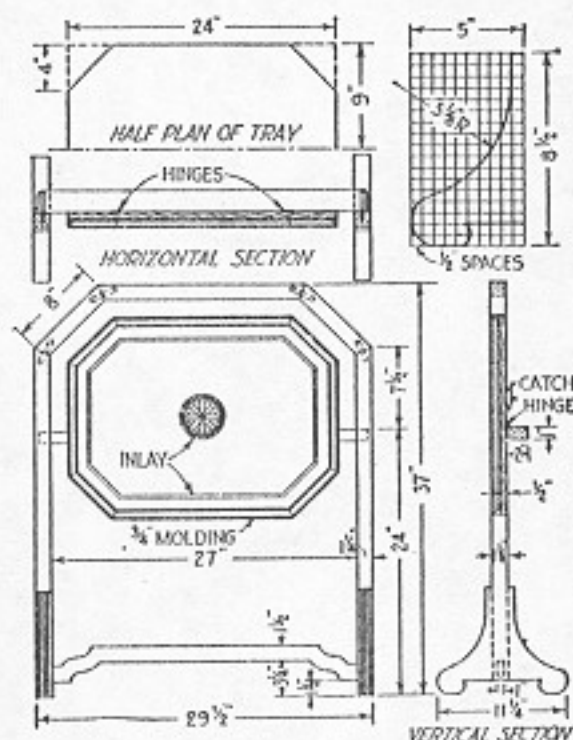


FIG. 37.—When this distinctive tea table is not in use, the top stands upright.

If mahogany is used for the three pieces of furniture described above, it is recommended to stain it with lime dissolved in water, as this does not discolor the inlay. If stained with bichromate of potassium or ordinary stain, the inlay has to be scraped afterwards with a very sharp knife to remove the stain, and this is a rather difficult and tedious process.

HOW TO DO VENEERING

Amateur woodworkers are prone to consider veneering a phase of woodworking entirely beyond the range of their abilities and to speak of it with a note of awe and longing in their voices. To demonstrate that the simpler forms of veneering are not beyond the abilities of any home worker with a fair degree of skill, the making of a veneered box will be described. It is such a box (Fig. 38) as any young lady will value as a gift from her father, her brother, or even more from some other girl's brother.

The box itself (Fig. 39) may be made of any easily worked, thoroughly seasoned $\frac{1}{2}$ in. thick wood, but the veneer should be mahogany, rosewood, walnut, or other fancy wood. Veneers can be purchased from some lumber dealers, from many plywood manufacturers and dealers in fancy woods, and usu-

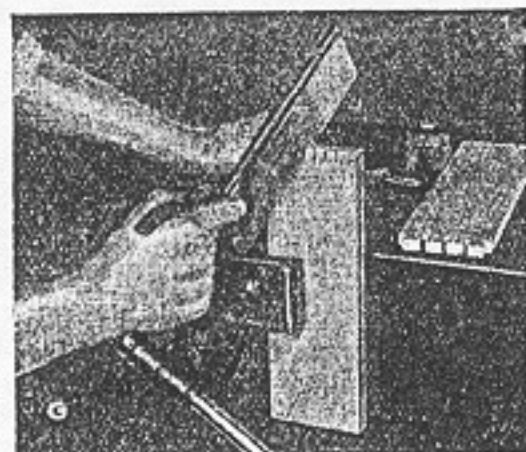
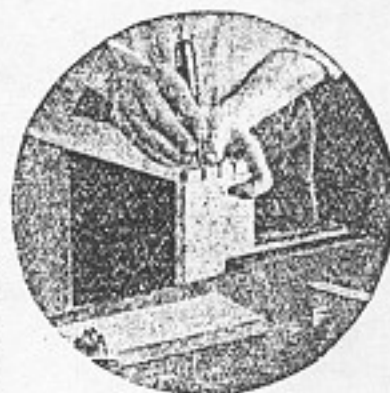


FIG. 31.—How to make a multiple dovetail joint of the type used in drawers. This is often called a "lapped" dovetail because the joint does not show from the front. It is one of the strongest and most craftsmanlike joints.

ally from cabinetmakers and furniture repair men.

The corners and the top and bottom of the box should be made with halved joints to reduce the amount of visible end wood, which might show beneath the veneer under certain circumstances. Fit the joints carefully to insure squareness, and glue and nail the parts together with 1-in. No. 16 brads, being careful that the nails will not interfere later on with sawing the box at C.

Before the top and bottom are

glued in place, cut $\frac{1}{4}$ -in. pieces the width of the space between the top and bottom inside of the box (about $3\frac{1}{2}$ in.) and just the length to fit snugly as indicated by dotted lines *D*. A drop or two of glue on the end wood will hold these pieces, which are to resist the pressure of the hand screws and prevent the sides and top from bending inwards when the veneer is clamped on.

Be sure the outside of the box is planed smooth, for rough and imperfect places will almost always show through thin veneer. As this article is primarily

a discussion of veneering, the box itself can be left to the skill of the worker without further directions.

The veneers for the ends should be cut about $\frac{1}{2}$ in. larger each way than the size of the box, as at *E*. Make straight, smooth cauls (blocks) of some soft wood about the size suggested at *F*. Provide pieces of folded newspaper to be placed between the veneer and the caul as at *G*; the paper will absorb moisture coming through the veneer from the glue. Set hand screws or clamps as at *H* ready for immediate use. Two may do but four will be better.

You are now ready for gluing. The room should be warm—at least 80° F., although 100° would be better. Heat the ends of the box, the veneer, and the cauls. Wax the latter with a piece of paraffin to prevent any danger of sticking.

Use rather thick glue of good grade, newly mixed and very hot. Equally important are the speed and skill of the worker. Spread the glue on one end of the box, not on the veneer; place the veneer on the glue, then add the paper and the caul. Turn the box to rest vertically on this caul and repeat the process on the other end.

Put the hand screws on without disturbing the cauls, and apply enough pressure to insure perfect contact. Too much pressure on such a small surface will force the glue out around the edges and "starve" the joint just where the greatest strength is needed. Another pair of hands to hold pieces in place, if you can get someone to help you, will simplify this process.

When the squeezed-out glue has hardened to a gummy texture, cut it away and save some trouble later on. Allow the box to remain at least twenty-four

hours, and longer if possible. On a broad surface more time would be necessary.

Trim the veneer to the other surfaces of the box with the utmost care. Prepare veneer, paper, and cauls for the sides of the box and repeat the gluing process, using six hand screws if they are available, although four will answer the purpose if placed judiciously. Allow the same time for setting and repeat the process upon the top. No veneer will be needed on the bottom, although a piece of felt, glued on the last thing, will finish the bottom correctly.

Sandpaper all the veneered surfaces. Round the corners slightly to prevent splintering, but not more than the thickness of the veneer.

With a sharp gage make an accurate line *C* $1\frac{1}{2}$ in. from the top. Saw very carefully around the box and remove pieces *D*. With a perfectly conditioned plane, smooth the sawed edges, being sure that no splinters are broken from the veneers. Be sure to make the joint fit accurately.

Cut strips of veneer $\frac{3}{4}$ in. wide and glue them around the joining edges of both box and cover. Gently rub each piece in place, after all are cut and fitted, with the flat face of a hammer. This must be done rapidly.

Glue the box edges first, for example, and place a piece of paper and a caul on the veneer and weigh it down while the veneer is being placed on the cover. Remove the weights from the caul and place paper and the cover upon it as shown at *J*. Apply hand screws with moderate pressure, and allow the work to set. Later trim and sandpaper the edge veneers.

Hang the cover with $\frac{3}{4}$ -in. narrow butt hinges or place small butterfly hinges on the back; the latter is by far the simpler. Cut in a small lock or catch, although either would be more orna-

mental than useful.

Make the tray about $\frac{3}{16}$ in. smaller than required to allow for the velvet lining which should cover the inside completely. Make the tray of $\frac{3}{16}$ -in. wood with butt joints throughout. Plane the front face of the tray back on a slight angle as at *K* to allow the cover to close without striking the front of the tray.

Finish with three or more thin coats of shellac, rubbed with No. 4/0 sandpaper between coats, and polish with a first-class grade of furniture wax.

FITTING HINGES EXPERTLY

Few problems give a more accurate measurement of a home worker's skill than the fitting of a pair of hinges. In doing this the only mark or cut that is "good enough" is that which is as near absolute accuracy as the worker can make it.

The exact length of the hinge *AA* in Fig. 40 should be marked from the hinge itself with a knife point. Never use a pencil where such accuracy is required. Line *B* should be made with a sharp gage set about the thickness of a piece of paper less than the parallel thickness of the hinge from the joint as shown at *E*, which will prevent the joint from becoming hinge bound. The gage line *C* should equal the distance between the edge of the hinge plate and the pin, as shown at *E*; if very fine work is desired, the distance should be as at *C'*, but *C* is commonly used.

In cutting to the lines, use a thin edged chisel about $\frac{1}{8}$ in. wider than the distance *C*. Make the first cuts as shown at 2, which will allow cuts *A* to be made accurately as at 3. Cut the wood away by using the chisel as at 4 and work carefully to depth line *B*. Place the edge of the chisel in line *B*, as shown at 5. Cut the wood away back to the line *C*; hold

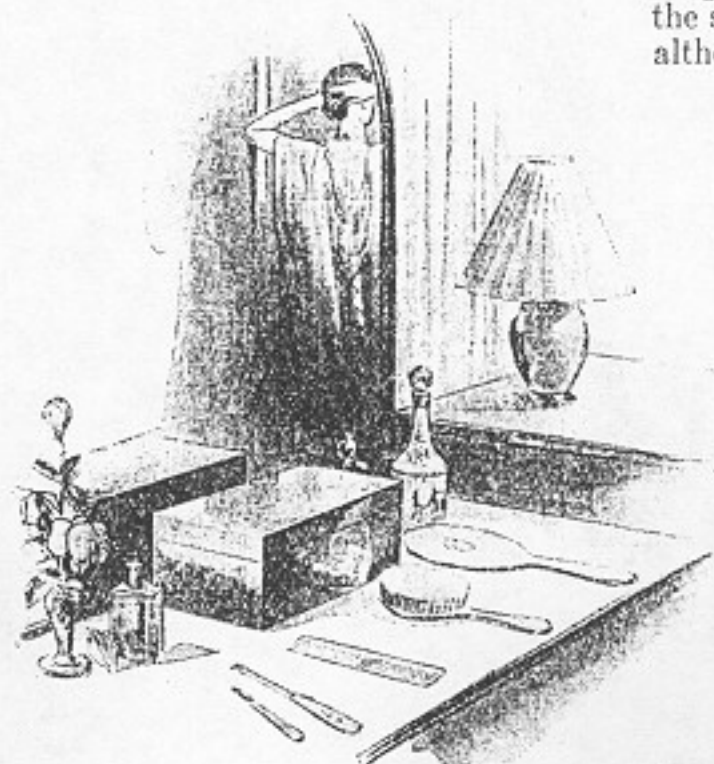


FIG. 38.—Attractive pieces like this trinket case or jewel box can be made by any woodworker who learns the art of veneering.

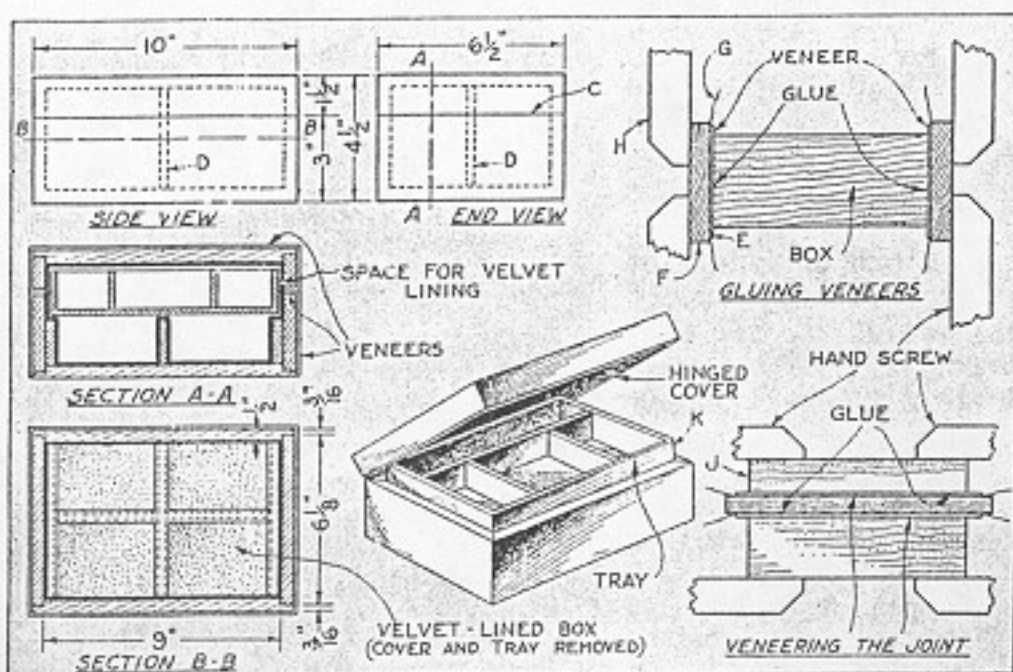


FIG. 39.—This box is a typical example of veneering within the range of home workshop equipment. Note the use of paper *G*, blocks *F*, and hand screws *H*.

the chisel as at 6 and cut gently, for there is danger of breaking out the wood back of C.

Trim the cuts carefully, making the lower surface or bed of the hinge ABC and the back cut straight and smooth as at 7. Fasten the hinges with screws as at 8. Be sure the pin is in accurate alignment with the corner D.

Lay out the distance C where each hinge is to be placed on the other member of the joint, and locate the exact endwise relationship. Set the hinges at these marks and drill a hole in the wood at the center of one hole in each hinge. Drive the screws until each hinge is pulled down to its place. Inspect the surface relations of the members of the joint. Small inaccuracies may be remedied by loosening the first screw of one

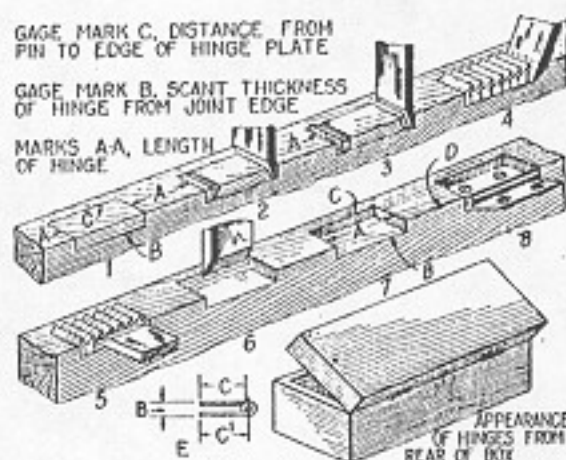


FIG. 40.—The steps to follow in marking and chiseling hinge mortises on box lids and cabinet doors.

or both hinges as may be necessary and drilling a hole for the other screw of each hinge close to that side of the hole, which will tend to force the hinge endways or sideways as may be needed.

FRICTION CATCHES FOR DOORS

The home worker often desires to keep the door of a cabinet or cupboard closed without the use of a lock, a latch, or a surface catch of any kind. The best solution is to apply a friction catch (Fig. 41), which is cheap, efficient, and, above all, easy to fit.

Ball friction catches usually range between $\frac{1}{4}$ and $\frac{1}{2}$ in. in diameter and $\frac{1}{2}$ and 1 in. in length. The size most commonly used for work about the house is $\frac{3}{8}$ by $\frac{3}{4}$ in., for a catch of that size may be safely placed in a $1\frac{1}{16}$ -in. rail or partition.

This type of catch may be purchased in almost any well-stocked hardware store. It is best to obtain the adjustable variety, if possible; then the ball may be screwed in or out to compensate for the shrinkage or swelling of the door. To turn the ball, it is necessary to insert the points of a pair of dividers in the slots or holes made for that purpose.

Fit and hang the door accurately, al-

lowing for the "sinkage"—let us say $\frac{1}{32}$ in. Then it is necessary to decide whether the catch is to be located in the top or bottom edge of the door about 1 in. from the lock edge, or in the lock edge of the door near the knob or pull.

If the face of the door twists out a little or is not perfectly straight at the top, the catch may be placed at the top; it will then hold the door straight unless it is too badly out of true. If the lower

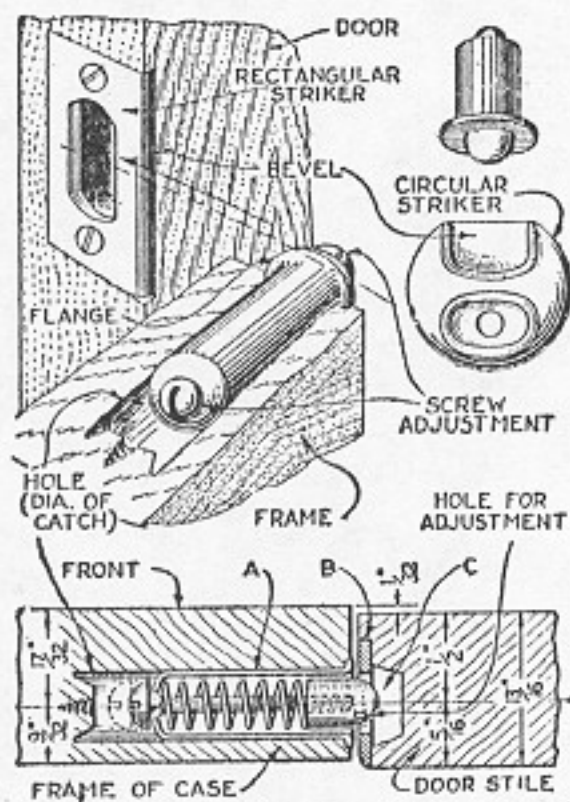


FIG. 41.—How a friction catch is inserted in a hole bored in the door frame and how the striker is fastened to the door.

corner springs out when the door is closed, the catch should be placed there. If placed near the center of the lock edge, the shrinkage of the door may demand more frequent adjustment of the catch, but the door can be opened and closed more easily.

Locate the center of the catch about as indicated, the dimensions being intended to show only the relation between the ball and the front of the frame as compared with the center of the striker socket and the face of the door. The dimensions will vary with the thickness of the door and frame and the surface sinkage of the door.

Bore the hole in the frame to receive the plug and drive the plug into the hole as at A. Close the door and work it back and forth a few times to mark upon the edge of the door the point where the center of the ball rests when the door is closed. A broad chalk mark made at this place to receive the track made by the ball will make the point show more definitely.

Place the striker plate on the door with its beveled edge facing the inside of the door as at B. Have the center of the striker socket coincide with the center point marked by the ball on the edge of the door.

Mark accurately around the striker with a sharp-pointed knife. With knife or chisel cut a recess to these lines so the face of the plate will fit closely, and of the depth to allow the striker plate to rest flush with the wood when fastened in place with screws. Cut away the wood under the striker socket to allow the ball to enter freely as at C.

If the frame of the door opening is not thick enough to receive the plug, it will be necessary to set it in the edge of the door. This is not so satisfactory as placing it in the frame.

DRAWER LOCKS

The first step in fitting an ordinary drawer lock of the type shown in Fig. 42, regardless of the size, is to lay off distance X of the lock from the top edge of the drawer front, adding a trifle, say $\frac{1}{4}$ in.—just enough so that the face of the lock will set below the edge of the drawer to allow planing if necessary. Mark this point with an awl, and through the front bore a hole as at A. This may be a $\frac{1}{4}$ -in. hole or smaller, depending upon the size of the lock. Push the projecting key pin of the lock into the hole from the back, center it, and pencil-mark around the front plate of the lock as at B. Lay the drawer front face down on the bench and with a fine saw make triangular cuts as at C.

Cut the wood out to receive the body of the lock as at D. Lay the lock in this space as at E and knife-mark around the

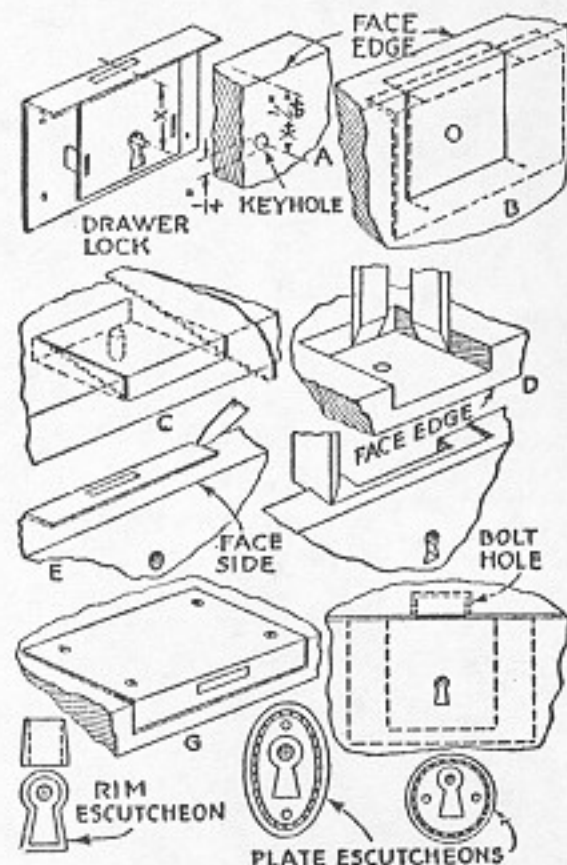


FIG. 42.—By following these steps, the amateur cabinetmaker can fit drawer locks easily and accurately.

faceplate. The back plate is seldom set flush with the inside of the drawer front, but this may be done, if desired.

Cut out for the face plate as at *F* and finish the keyhole with a pad saw or keyhole saw. If the work has been done accurately, the lock should appear about as at *G* when it is fastened in place.

Run the drawer partially in its case. With the key turn the bolt out and touch the face with black grease or paint. Close the drawer and turn the key until the bolt stops against the partition, as at *H*. This will leave a black mark on the wood. Remove the drawer and with a chisel a little wider than the thickness of the bolt, cut out the bolt hole.

FITTING A NIGHT LATCH

Many home workers have fitted night latches successfully, but others have not been so fortunate in their attempts. A few suggestions which do not usually appear in the printed instructions accompanying the locks may be of help in simplifying the work.

We shall consider first the fitting of a rim spring latch of the standard type in the usual way for a right- or left-hand door (Fig. 43). Locate the desired height of the latch, about 3 ft. 6 in. from the floor but somewhat less if the approach is from a porch floor that is lower than the floor of the house. If the distance from the center of the cylinder to the edge of the door is supposed to be 2 in., it is well to mark it actually $2\frac{1}{16}$ in., so as to set the latch back $\frac{1}{16}$ in.; this allowance is for planing, should the door stick at any time. Bore a 1-in. hole entirely through the door stile.

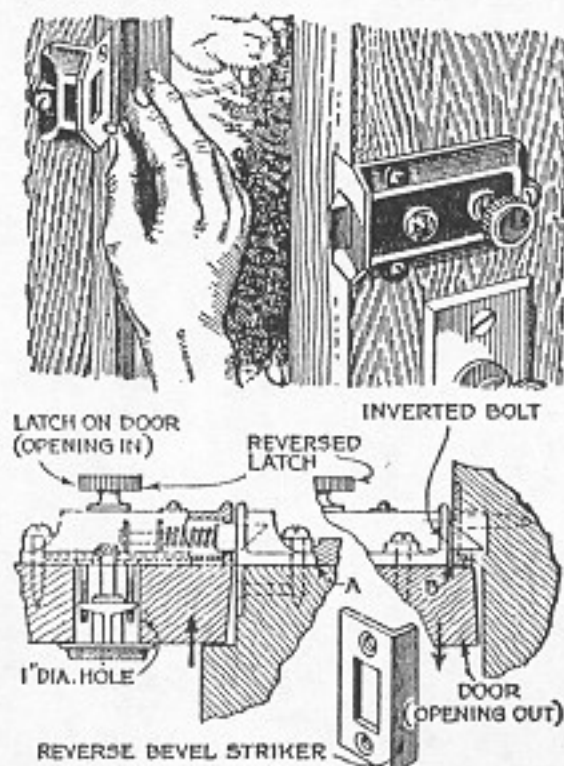


FIG. 43.—A standard night latch can be fitted in two ways, depending on whether the door is one opening in or out.

Break the connecting bar and the screws as indicated on them to suit the thickness of the door. Slip the cylinder through the outside ring until the back

of the face is seated. Insert the cylinder from the outside of the door with the keyhole down. Place the false cap or perforated plate on the lock side with the screw holes above the center. Drive home the two connecting screws that fasten the false cap, the cylinder, and the face ring firmly in place. Locate the latch accurately and drive the screws which hold it in place on the door.

To apply the striker—the member which is engaged by the latch—it may be necessary in certain cases to cut into the door casing as at *A*, as well as into the edge of the door jamb.

In fitting a night latch on a door opening out, the lock must be set back far enough from the edge of the door to clear the corner of the rabbet at *B*. We shall assume that the rabbet is $\frac{1}{2}$ in., which, in the case of a close-fitting door, will require that the cylinder center should be set back about $2\frac{1}{16}$ in. This must be verified in every case. Bore the 1-in. hole, remove the backplate of the latch, reverse the latch itself, replace the backplate, and proceed as previously described.

A reverse bevel striker must be fitted to the rabbet so that the latch will engage. The striker should be set in a notch cut into the jamb to receive it as illustrated.

When locks and other hardware are of unusual design, the manufacturers supply full instructions for fitting them.

CRAFT WORK WITH NEWSPAPER

When used in conjunction with a boiled starch paste, newspaper becomes an ideal material for many construction purposes. From it numerous articles have been made, including the astronomical camera and boat illustrated in Fig. 44.

First a framework is constructed, preferably of wood, having slats that are placed fairly close together. The spacing of the slats depends, of course, on the desired final strength.

Next prepare a generous quantity of boiled starch paste. Take sufficient water for the amount of paste required and heat to boiling. While this is heating, mix common starch in a small quantity of cold water until it is perfectly smooth and of the consistency of heavy cream. When the water is boiling violently, remove it from the fire and stir rapidly while pouring the starch mixture into it. Keep on adding the starch until the paste is about the consistency of molasses. Use a good and reasonably stiff brush for applying the paste, and coat the wood frame first; then coat the paper with paste on both sides and apply it to the frame. If the paste is of the correct consistency, the paper will

absorb it and appear quite wet.

Layer after layer of paper is applied in this manner until from six to twenty or more layers have been used, according to the required strength. The paper should be forced into complete contact with the preceding layer with the paste brush. Apply pieces of all shapes and sizes, torn to shape rather than cut, as

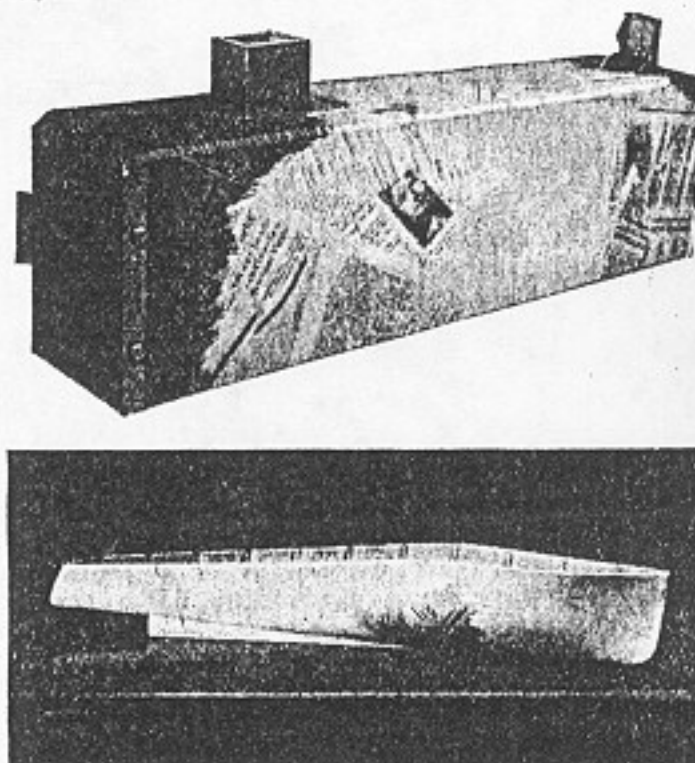


FIG. 44.—The astronomical camera shown above was covered by using newspaper strips. The model hull shown below was constructed by pasting many layers of newspaper on a framework of thin wood strips built to the shape required.

the ragged edges are less liable to form ridges on the finished surface.

As the paste dries it will cause the paper to contract and the finished article will be found to be very smooth and almost as hard as vulcanized fiber. In spite of its smoothness and hardness, it will not be brittle and therefore will

not break easily. The covering can be sandpapered and even filed to remove any inequalities in the surface. Any desired finish can be used.

DRILLING GLASS

For small holes in either window glass or plate glass, a triangular saw file makes an acceptable drill. Grind the point to make three surfaces corresponding to the sides of the file as shown in Fig. 46. It is better to use a grinding wheel that runs in water or oil in order to be sure not to heat the file, but if a dry wheel must be used, apply the file with very light pressure and dip the tip in water often. If the temper is drawn, the file is useless.

To prepare the surface of the glass for drilling, mark the place for the hole by a scratching action of the point of the file. Then make a circular container around this mark, using putty or other plastic substance. Leave the glass ex-



FIG. 45.—The way a file is held in a brace for drilling glass. Note the ring of putty which retains the turpentine.



FIG. 46.—How the point of a file is ground for drilling glass.

posed in the center and fill the little bowl with turpentine.

The drilling is done with the file in a brace as shown in Fig. 45. A breast drill or a hand drill can be used for greater speed. Use light pressure and reverse the glass as soon as the point goes through.

The process of drilling in this manner is not rapid but, unless a large number of holes are to be made, it will prove satisfactory. The size of the file selected will, of course, determine the maximum size hole that can be drilled in this way.

For larger holes effective work can be done by using a brass tube. A suitable piece of tubing often can be had for the

asking at a plumbing shop. Some such device as that illustrated in Fig. 47 is necessary for holding the tubing in place and perpendicular to the glass. It consists of a baseboard upon which the glass rests, a small block to serve as a spacer, and a two-by-four through which has been bored a hole just large enough to allow the tube to rotate freely.

In the process of boring with a tube, which should be cut square on the end, carborundum or other abrasive powder is used as the grinding agent. In order to allow this powder to enter under the edge of the tube, eight or more shallow notches are filed in the end.

The jig is then fastened on the work-table as shown in Fig. 47, and the plate

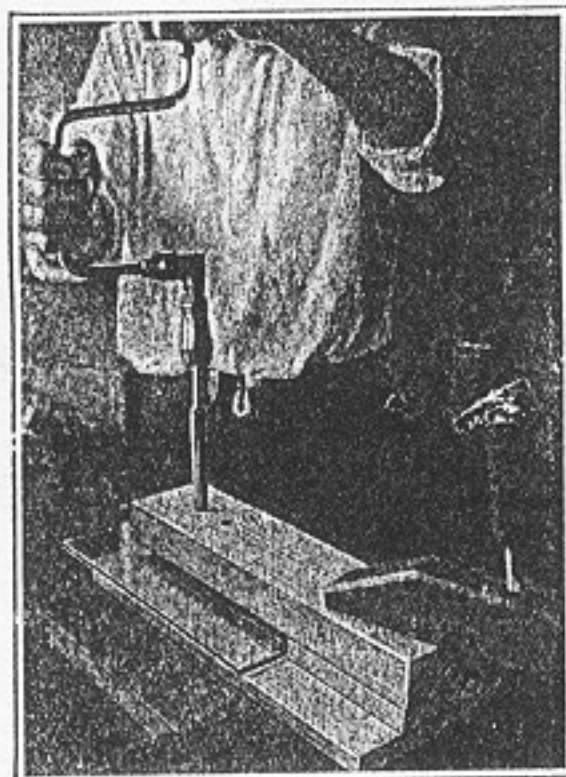


FIG. 47.—Grinding a hole in plate glass with a brass tube charged with abrasive powder.

placed in correct position under the tube. Carborundum powder may be poured into the tube or applied outside of it, together with a small amount of water. The glass is clamped down or wedged in to prevent its moving when the boring begins.

A rose countersink or a reamer set in the brace or drill stock will serve to rotate the tube, for no great power is nec-

essary. The use of a drill press or lathe or any other application of motor power reduces the time necessary for the job.

If care is taken, the tube can be allowed to cut through the glass, but a safer way is to reverse it, provided the jig can be fixed in exactly the right position on the opposite side.

A little practice will teach just how much pressure can be applied for best results in cutting. After the groove has been made, it should be kept filled with water; and additional abrasive should be applied when necessary. If the edge around the hole is somewhat sharp or rough, polish it with carborundum powder held on a piece of wet cloth or rubbing felt.

For use with the tube method of drilling—or, more properly, grinding—glass, an efficient guide can be made from a cut iron washer with a hole slightly larger than the drill tube (Fig. 48). A bit of beeswax is melted and poured on

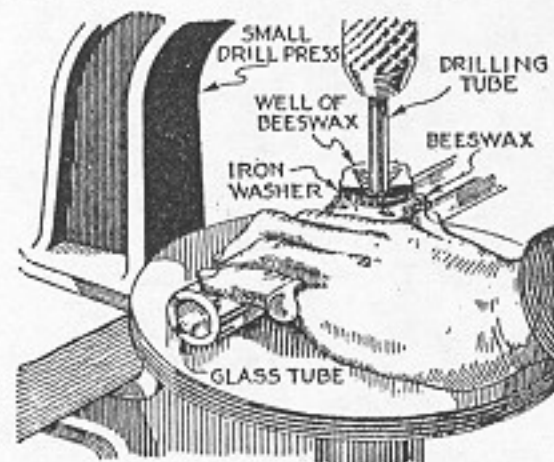


FIG. 48.—An iron washer and beeswax serve as a guide for drilling glass tubing.

the place to be drilled, and the washer is pressed into it.

The surplus wax is removed from the hole in the washer and, with a little additional wax, is formed into a funnel-like well about the drill. The well is filled with turpentine or water, and the drilling proceeds as usual. This method of making a guide is easily applied to flat sheets or to convex surfaces and gives rigid support at the cutting edge of the drill where it is most needed.

GODEY'S LADY'S BOOK AND MAGAZINE. JUNE 1872

MAHOMETANISM ESTABLISHED.

The Koran had been accepted by the followers of the dead prophet. In this, his sacred book, he sets aside reason, stifles conscience, represses inquiry, forbids private judgment: the only moral responsibility he acknowledges is that of implicit obedience to the laws of the Koran as the ultimatum of truth, of knowledge, and of righteousness. His creed was made for all men; those who refused to accept it were to be subdued or destroyed. His followers of every name—Persians, Moors, Arabs, Turks, representing the three Continents of Asia, Africa, and Europe—were united in rejecting the divinity of Christ, and hating Christianity. War was their great argument; their aim was the sovereignty of

the earth. Nor was power the only reward offered to true believers. The harems of this world and the houries of heaven were to be theirs. It was not strange that they seized upon his promises, so flattering to the pride and the passions of men. They made of warfare for the faith the profession of their lives, the avenue to gain and glory. Like a consuming fire, driven by a furious wind, they burst over the Eastern churches, offering only the alternative of destruction or conversion. The sacred buildings of these degenerate sects were levelled to the ground, or transformed into mosques, where none but men might enter, worshippers of Allah and of Mahomet his Prophet.

How To Build It 1964

WHIRLING SAUCER

SAUCER RIDE, teeter-totter, wagon and sand box are combined in this backyard amusement device—a four-way fun toy for ages 3 to 13.

For materials you will need two 4x8 sheets of $\frac{3}{4}$ -in. exterior-grade plywood, a 4x8 sheet of $\frac{1}{8}$ -in. Masonite tempered hardboard and four double ball-bearing casters.

Cut the base, the bottom of the saucer and the two rings from $\frac{3}{4}$ -in. plywood. The sides of the saucer are formed from the hardboard.

Assemble the saucer, using water-resistant glue and screws.

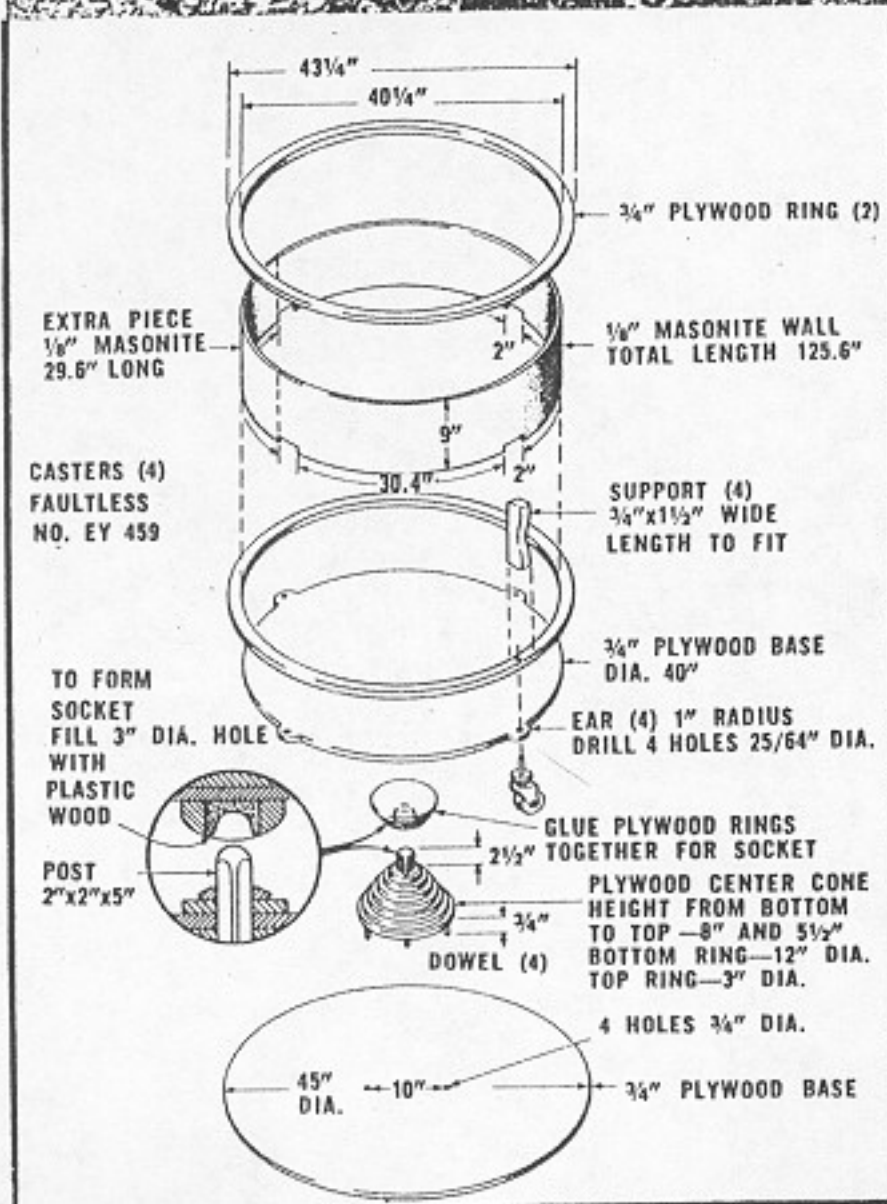
The cone on which the saucer turns is constructed from graduated rings cut from plywood scraps. Glue these together and build up to the desired height around the center post-pivot. Use a rasp and sandpaper to shape the pivot head.

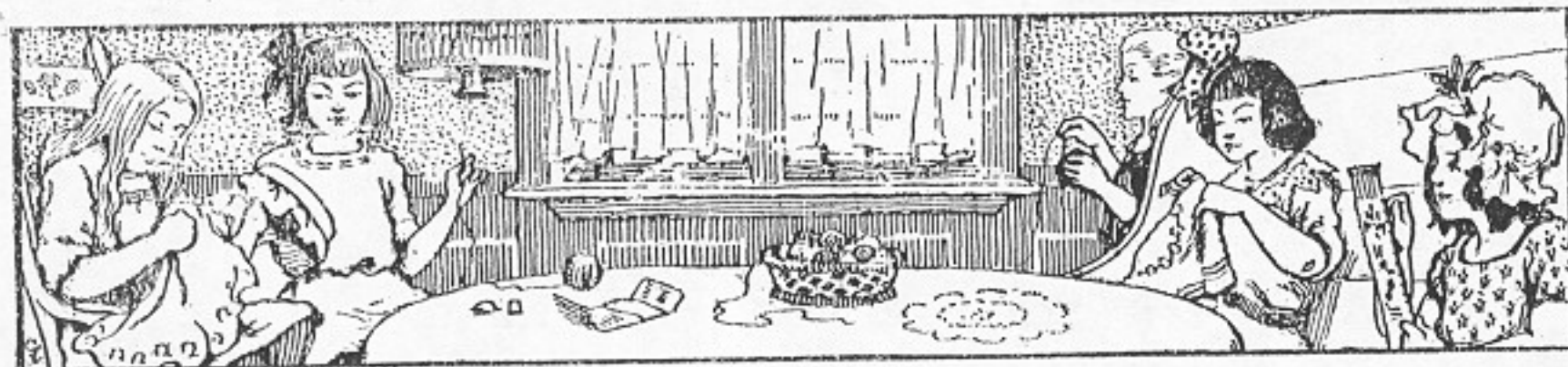
Make up two different size cones: a low one for toddlers and a higher one for youngsters who might enjoy a wilder ride. These cones can be installed with dowels for easy switching.

Form the socket with plastic wood as shown and attach to the saucer bottom.

Finish the saucer in bright colors and turn it over to the youngsters. They'll love it. When not whirling, they'll be using the saucer as a see-saw. They also will find that the saucer can be taken off the base and used on smooth surfaces as a wagon and an easily maneuvered sand box.*

—Henry B. Dabkowski





AMATEUR CRAFTSMAN, 1914

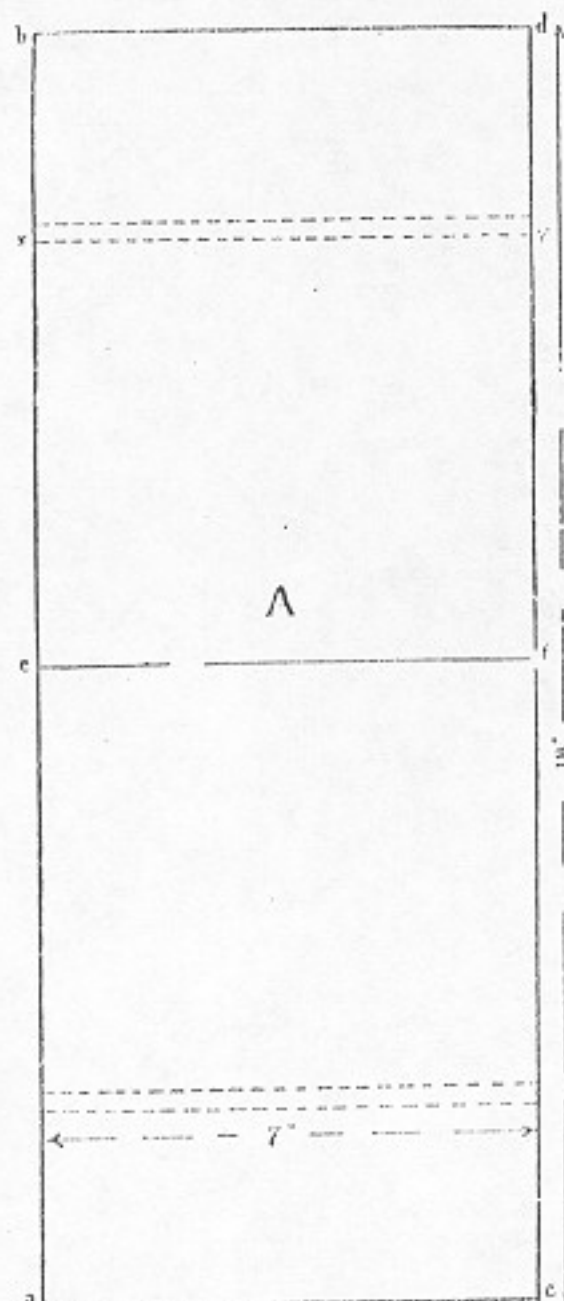
NEEDLEWORK

WHO has not pleasant memories of the fair little girl who sat under a tree sewing as long as her eyes could see? A picture of home is hardly complete without a woman sewing in it.

The stories of chivalry would lose a part of their charm if from them the fair ladies working bright figures in tapestry were to be removed and sewing machines put in the place of needles! Sewing is a form of handicraft that even boys should know something about. What would Robinson Crusoe have done without the ability to sew? Many a boy has found, when off in camp or away to school, and many a man discovered while traveling, how useful an art sewing is. One ought to be able to sew on buttons, to darn stockings, to mend a tear, and to make a cloth bag, at least. But sewing like any other craft becomes a pleasure only through practice until some degree of skill is attained. And even then the craftsman has but a fraction of the pleasure he might have, unless he is able to make his work beautiful as well as useful.

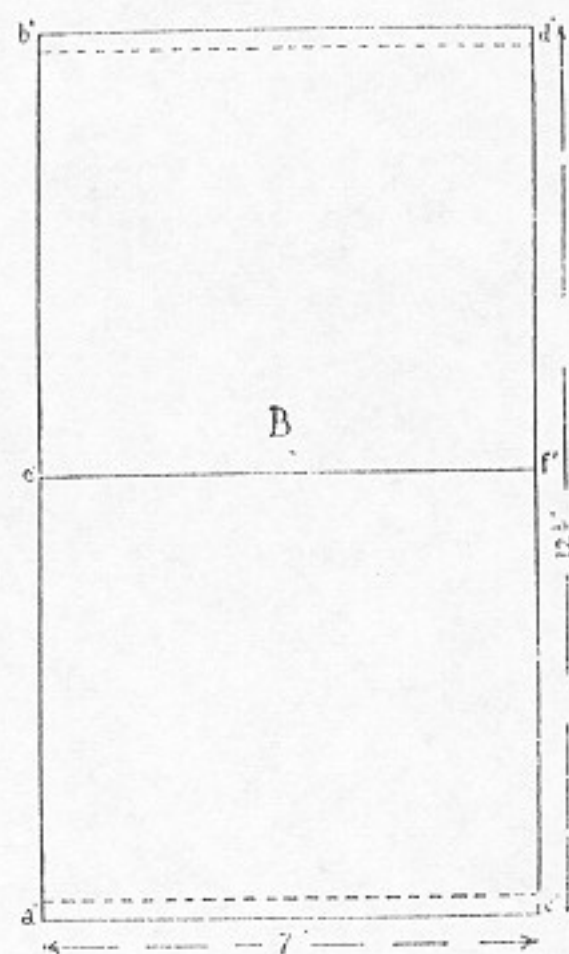
One does not long enjoy producing merely commonplace things. It is an inspiration to good work to know that common objects need not be commonplace. Take for example such objects as a traveler needs. Here is a whole set of such objects, all having possibilities in the direction of the beautiful. Have courage to

start such a set. A simple object easily made comes first, the more difficult ones later. Your skill will increase as you proceed, and your pleasure in what you are doing will grow with



Sponge Bag or Washcloth Bag

A = Muslin Cover. B = Lining.

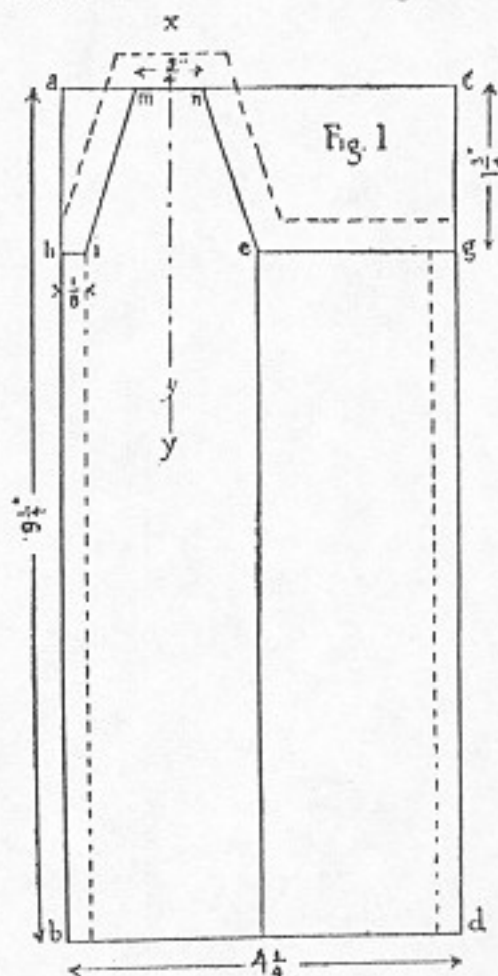


Sister May.

the visible results. Only do not hurry, do not allow yourself to feel hurried. Having begun the good work, do only so much upon it each day as you can do thoroughly well. Let your rule be that of Nature itself:

"Without halting, without rest
Lifting better up to best."

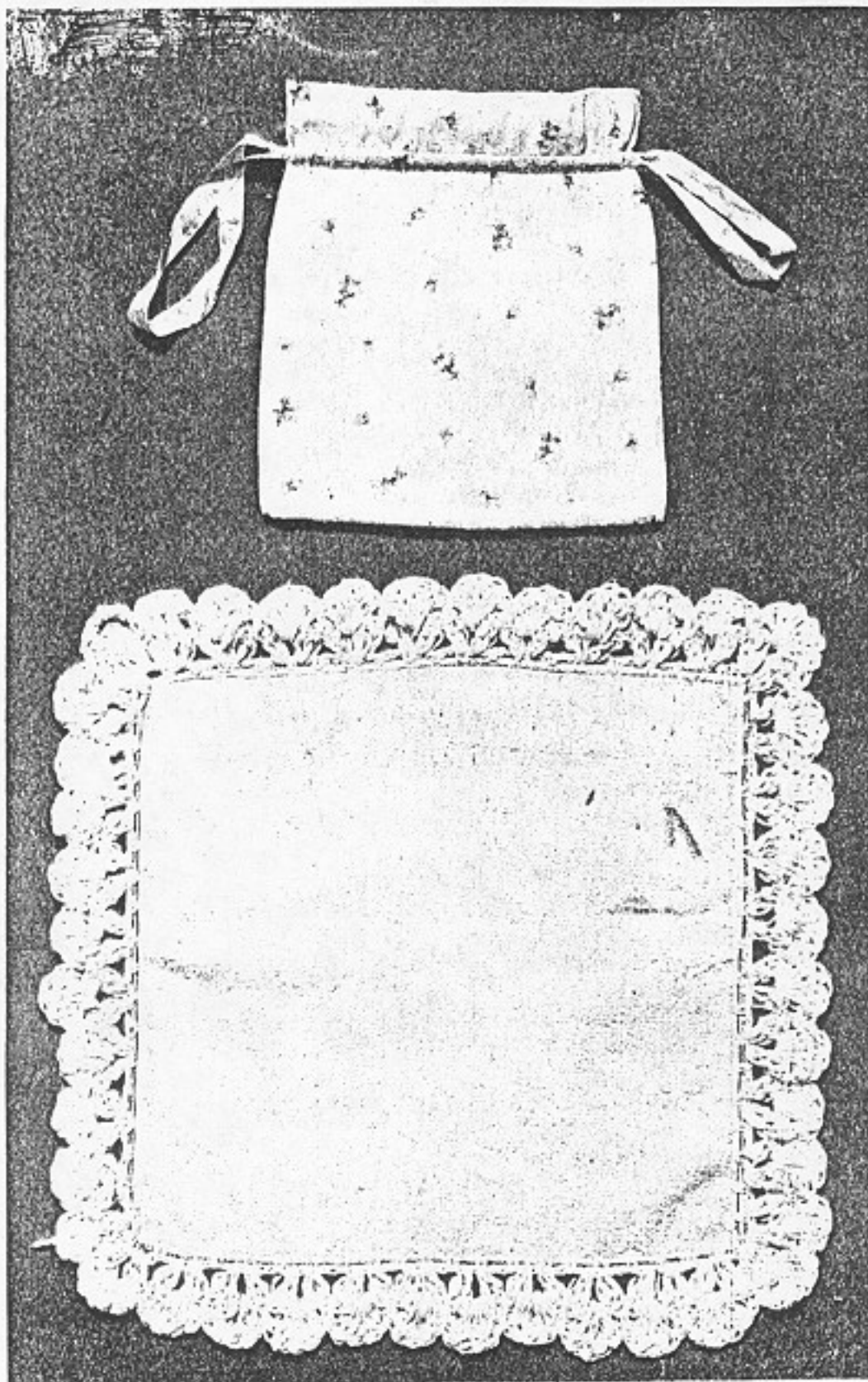
SPONGE BAG or WASHCLOTH BAG, the WASHCLOTH and a TOOTHBRUSH HOLDER, of a set of traveler's articles for a person going to Europe. Materials: dotted Dresden muslin, in a rosebud pattern of pink and green, lined with stork sheeting. The finished articles are also pictured. Cut lengthwise a strip of muslin, A, 18" long and 7" wide. Cut a strip of stork sheeting, B, 12½" long, and 7" wide. Fold *a* on *b* and *c* on *d* with the wrong side out and sew the edges together with a ¼" seam. Turn the bag. Fold *a'* on *b'* and *c'* on *d'*, wrong side out, and sew the edges together with a ¼" seam. Fit the lining inside the muslin bag, *ef*, corresponding to *e'f'*. Turn in the top and with a hem of 1½" sew the muslin on to the lining upon the dotted line *xy*. Three-eighths of an inch above this line stitch again, making a place for the draw ribbons. Draw in at *x*, around the bag and out at *x*, a ½" ribbon 20" long. Sew the ends of the ribbon together. Draw another ribbon 20" long in at *y*, around



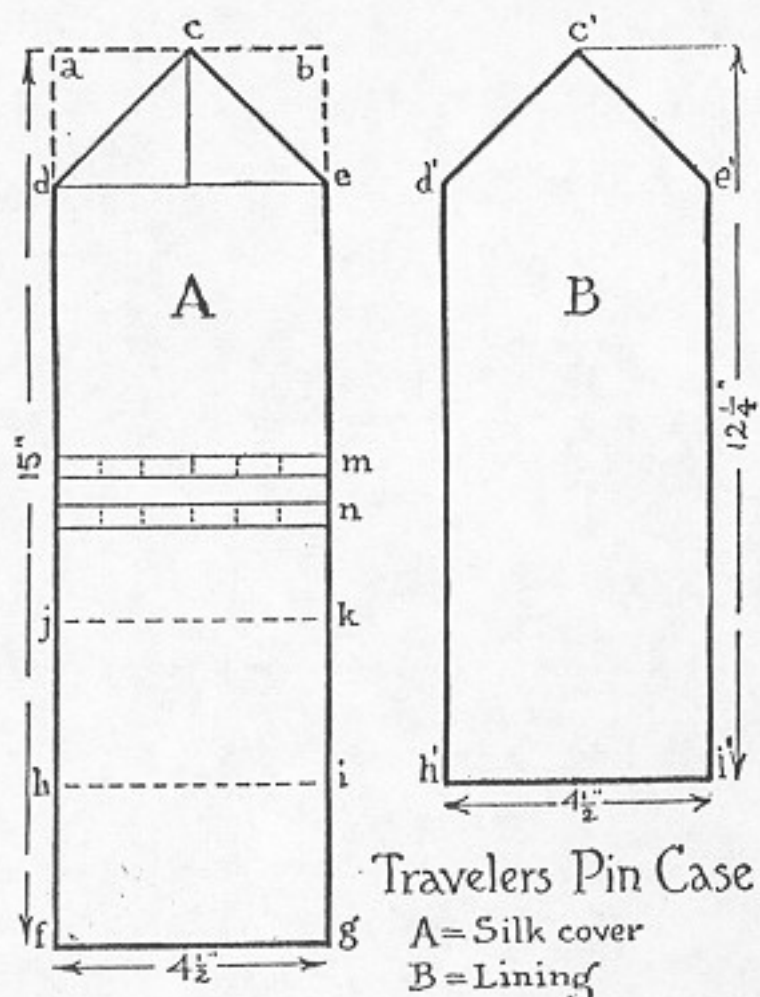
the bag and out at *y*. Sew the ends together, and the bag is finished.

The WASHCLOTH was made of a 10" square of Turkish toweling, neatly hemmed and bordered with a double crochet and scallops made with cotton yarn No. 20. Another durable material is the "rubdry" toweling, which is be-

coming almost as popular as the Turkish. And surely it is not out of place to remind



the younger travelers that any washcloth should be daily aired. The TOOTHBRUSH HOLDER requires a strip of stork sheeting cut lengthwise, *abcd*, 9¼" long × 4¼" wide. Cut the top like the diagram. Cut the outside the same, but allowing ⅜" at the top as per dotted line. Bind the top of the lining, *l, m, n, e, g*, with English twilled tape. Hold *hk* on *gd* and sew across the side and bottom on the woven side. In like manner stitch the outside and turn. Fit the lining to the outside. Turn in and fasten the muslin with blind stitch to the binding, leaving enough of the binding out to show like a cord. At *x*, sew a loop of white silk rubber cord, a pearl button at *y*.



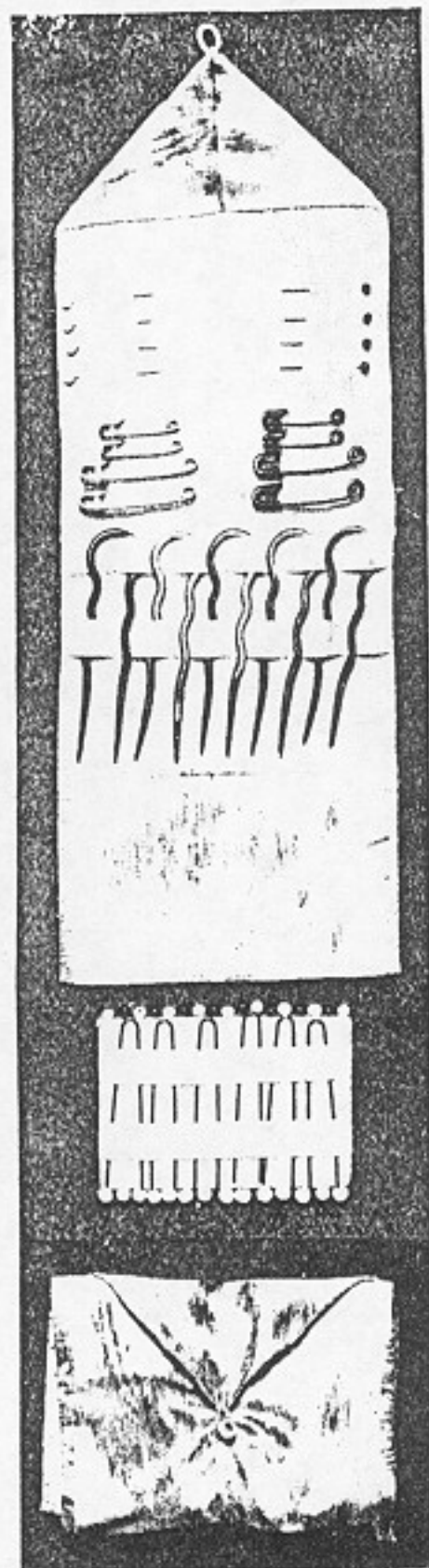
Travelers Pin Case

A = Silk cover
B = Lining

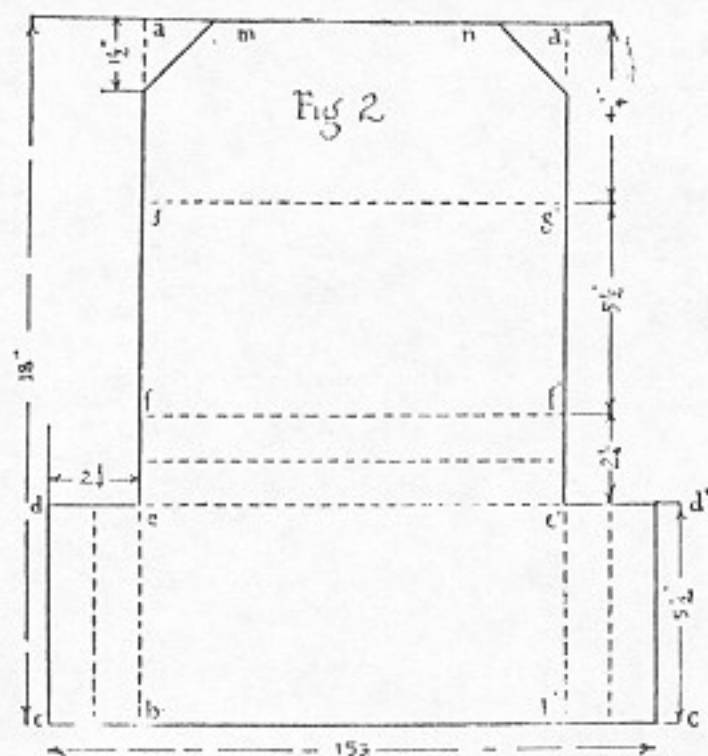
TRAVELER'S PIN CASE. One of several articles for a traveler's general outfit. For the Pin Case, for material it would be well to use flowered ribbon in pink and white lined with white French twilled flannel and bands of half-inch pink ribbon. Ribbon is 16" long. Fold *a* on *b*. Sew *ca* and *cb* together in $\frac{1}{4}$ " seam. Press open the seam and arrange to form triangle *dce*. Turn $\frac{1}{2}$ " hem at *fg*. Baste $\frac{1}{4}$ " fold on each side of lining, *d'* to *h'*; *e'* to *i'*. Cut along lines *d'c'* and *c'e'*, forming triangle like *dce*. Overcast *h'i'*. Adjust lining to outside. Slip triangle *d'c'e'* between folds of silk *dce*. Hem *dc* on to flannel lining. Fold *f* on *j*; *g* on *k* to form a pocket. Sew over and over lining to outside from *d* to *h*; *e* to *i*. Adjust ribbon bands at *m* and *n*. Stitch vertically, as indicated by dotted lines, forming spaces for hairpins. The other pins attach to the flannel lining. Finish with a buttonhole-stitched loop at the apex of the triangle and button $6\frac{1}{2}$ " from the apex, to hang it by if desired. The pocket contains a card with more pins.

It is made of two pieces of cardboard or calling cards $2\frac{1}{4}$ " $\times$ $3\frac{1}{4}$ ". Cover one side of each with silk $3\frac{1}{4}$ " $\times$ $4\frac{1}{4}$ ". Fold the edges over the cardboard. Draw the opposite sides together with long stitches. Adjust the ribbon bands. Stitch across vertically to form spaces for hairpins. Sew the two pieces of cardboard together,

~~then~~ bend over. This forms a place to fill with pins. A pin case may seem an unimportant item for a traveler. Consider what a pin means. It may save your dignity, when it takes the place of a suspender button gone astray just as you expect to deliver your part in a ship's concert, or at a hotel party. It may preserve your modesty when it prevents a bare knee or elbow from sticking through a sudden rent. It may help to retain your health when the raw wind has demanded admittance to your chest by way of a collar that will not stay turned up. Or it may even save your very life, by holding together the bandage applied to a bleeding cut. All this we may owe to the common wire pin, not to mention those variations of the pin family such as are shown in the actual picture of the Pin Case. Consider the ways of the safety pin. In its infancy it secretly holds down Sister's collar at the back, and in its gigantic adult vigor it grips the folds of the horse blanket like a vise. In the form of a brooch, what security it gives to the loveliness of a gem. The common pin, over-trusted in certain places, is like faith without works, where the safety pin is a sure foundation. But the pin may innocently lead to slovenly habits, for, allied with a tendency to saving, it may appear in groups or rows upon the hem of the gown or on the breast. The case does away with all that.



Two Cases for Rubbers.



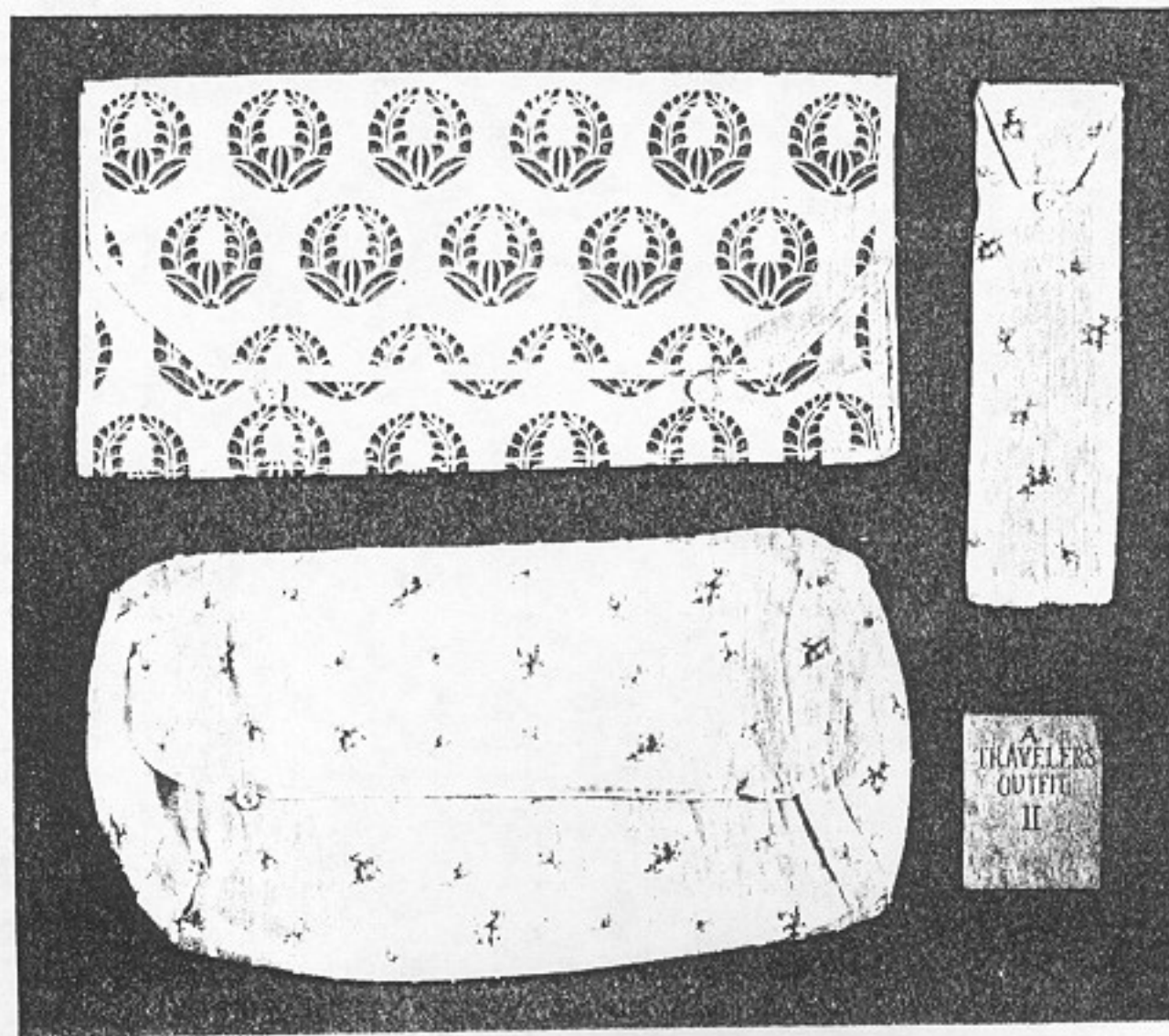
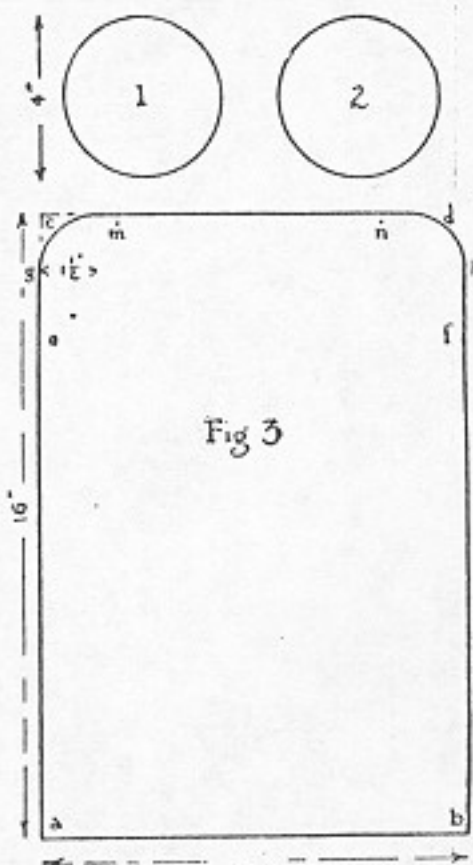
TWO CASES FOR RUBBERS. The two shapes are different, and illustrate the fact that we may often get the benefit of mental and manual exercise by the use of two or more routes in reaching the same goal. Fig. 2 is made of stork sheeting, and decorated with the stencil. Fig. 3 is made of Dresden muslin lined with stork sheeting. Fig. 2 is made thus: Cut a strip of stork sheeting lengthwise like the diagram, *ab* being 18".

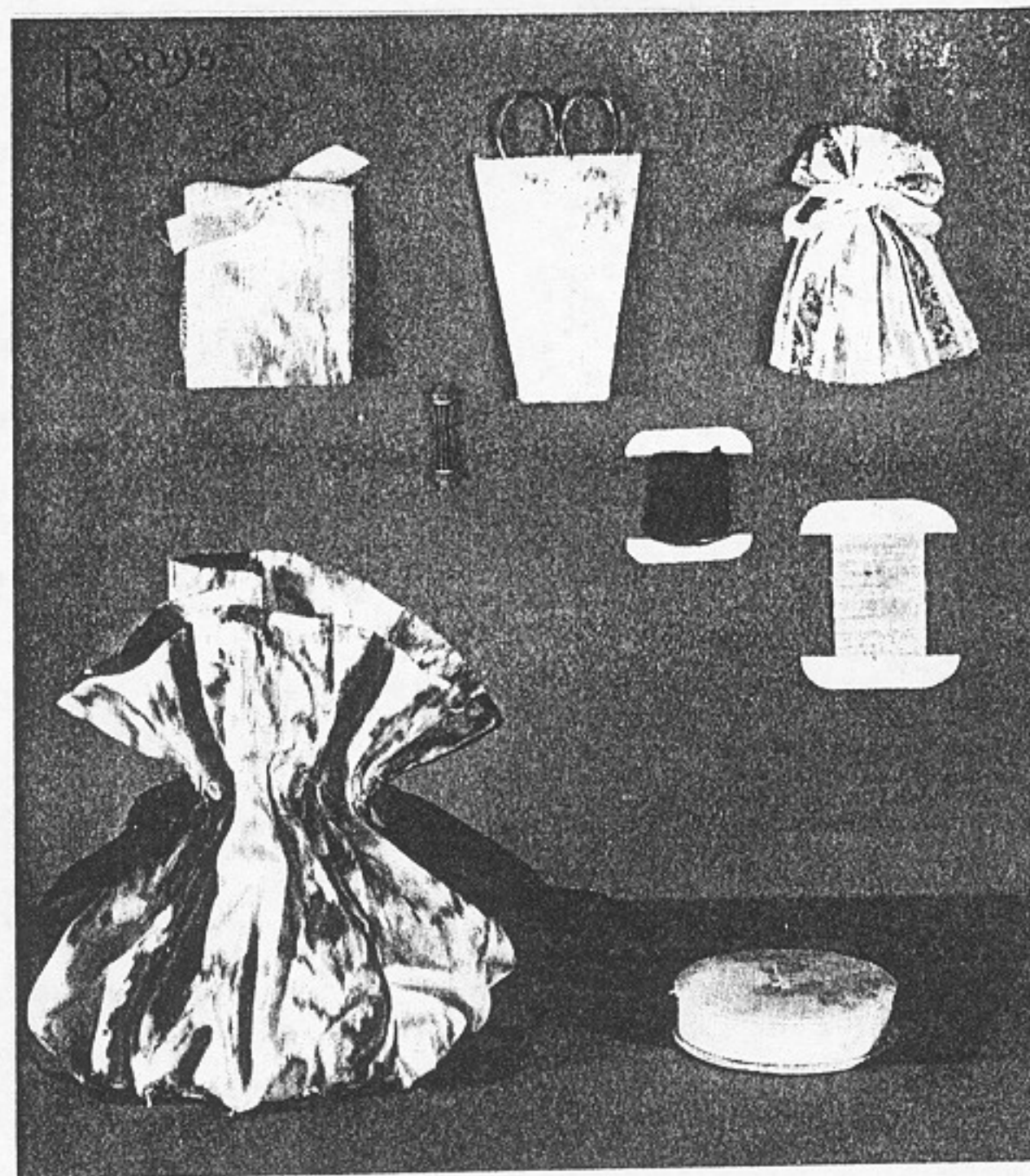
cc is $15\frac{1}{2}$ "; *cd* is $5\frac{1}{2}$ "; *de* is $2\frac{1}{4}$ ". Bind *cc* with tape or binding ribbon. Hold *ed* on *ef*, also *e'd'* on *e'f'*. Sew a seam on the outside. Crease the case on lines *eb* and *e'b'*. From *k*, sew binding on *ke* across seam *ef*, *fg*, around *g*, *a*, *a'*, *g'*,—seams *g'f'*; *f'e'* and the folds *e'b'*. Sew on loops at *mn*, and buttons to correspond at *x* and *y*.

Crease the case on the dotted lines and fold inward, to make flat when not in use.

Fig. 3 is made with lengthwise strips of muslin and stork sheeting 16" long and 11" wide. Two circles each of muslin and sheeting, 4" in diameter, will form the ends. Round the corners as in diagram. Bind stork sheeting across end *ab*. Begin at *a* and sew *ae* on to circle 1, *bf* on to circle 2;

seam on the woven side of sheeting. In like manner put the muslin together, seams on wrong side; turn; fit the lining; fasten together by binding the end *eghf*. Blind stitch *ab* on to binding of the lining. Finish with loops of white silk elastic at *m* and *n* and adjust the buttons. In selecting the goods pattern, or putting on your own decoration, be sure it is not out of keeping with the contents. This is one of the most useful of the utility presents. For no matter how clean the rubbers are brushed, no one wants them against clean things in the baggage.



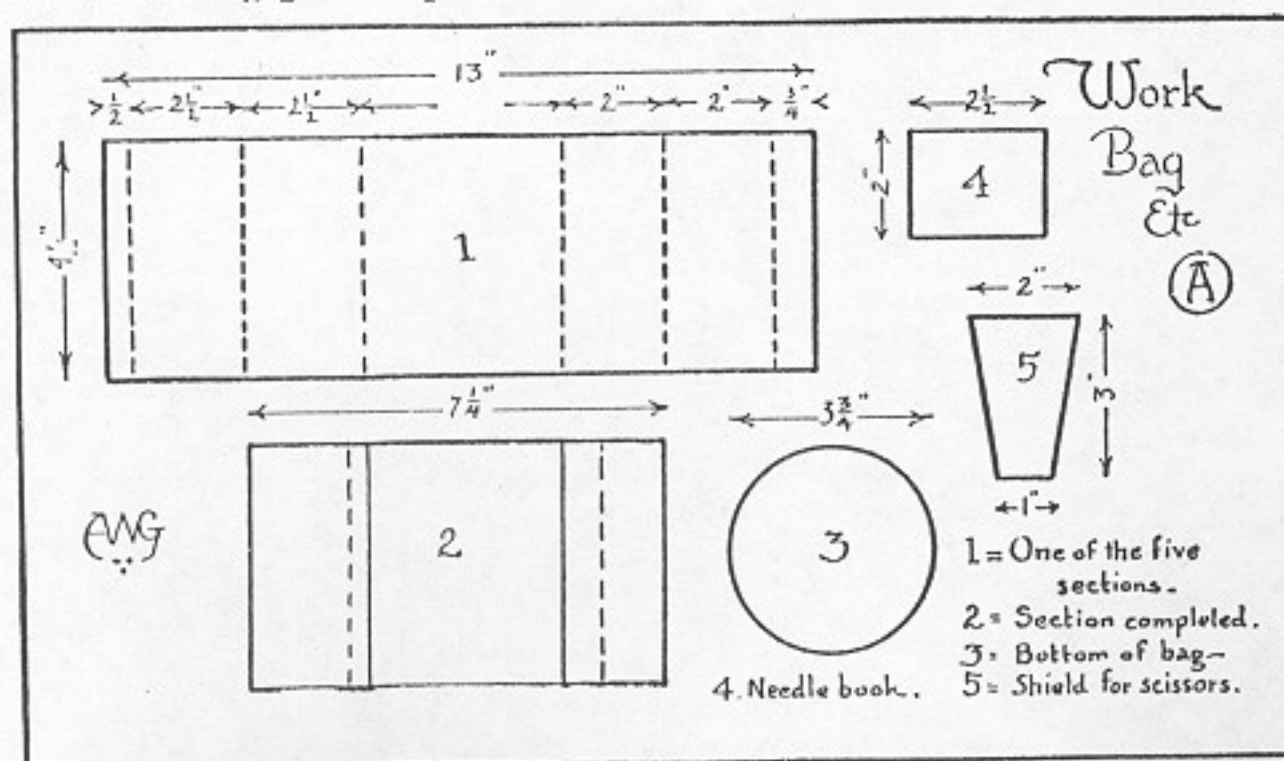


ribbon. Make two button-holes in this space on the outside. Adjust $\frac{3}{4}$ " draw ribbons, each 1 yard long. For directions, those for the Sponge Bag will suffice. Gather the lower edge of the bag. Gather the circles of silk $\frac{1}{4}$ " from the edge. Fit to the cardboard, drawing up the thread and fastening on the wrong side.

Over-and-over two circles together. This affords a pin ball for the completed bag. Over-and-over circle to the bottom of the bag. Some of the contents of such a bag are shown in the illustration; there is the needle-book, at the upper left, the scissors-case or shield, a button bag, shown at upper right hand, bobbins wound with colored silk, skeins of cotton, the case for tape and ribbons lying to the right of the Work Bag, and, though not shown, the glove darning and skein of parti-colored threads are handy

A SEWING BAG. Cut five 13" lengths of $4\frac{1}{2}$ " ribbon of the Dorothy Dainty style. Ribbon with a dark serpentine border is effective in the finished bag. Cut two circles of silk $4\frac{1}{2}$ " in diameter; two circles of light-weight cardboard $3\frac{3}{4}$ ". See Fig. A. To make: Over-and-over the five strips of ribbon together. Make $\frac{1}{2}$ " hem on the lower edge. Fold again $2\frac{1}{2}$ " in depth to make pockets. Fold over the upper edge of the bag $\frac{3}{4}$ ". Fold again 2" in depth, for the ruffle finishing the top of the bag. Hem or stitch this down. Stitch again $\frac{1}{2}$ " above, making space for the draw

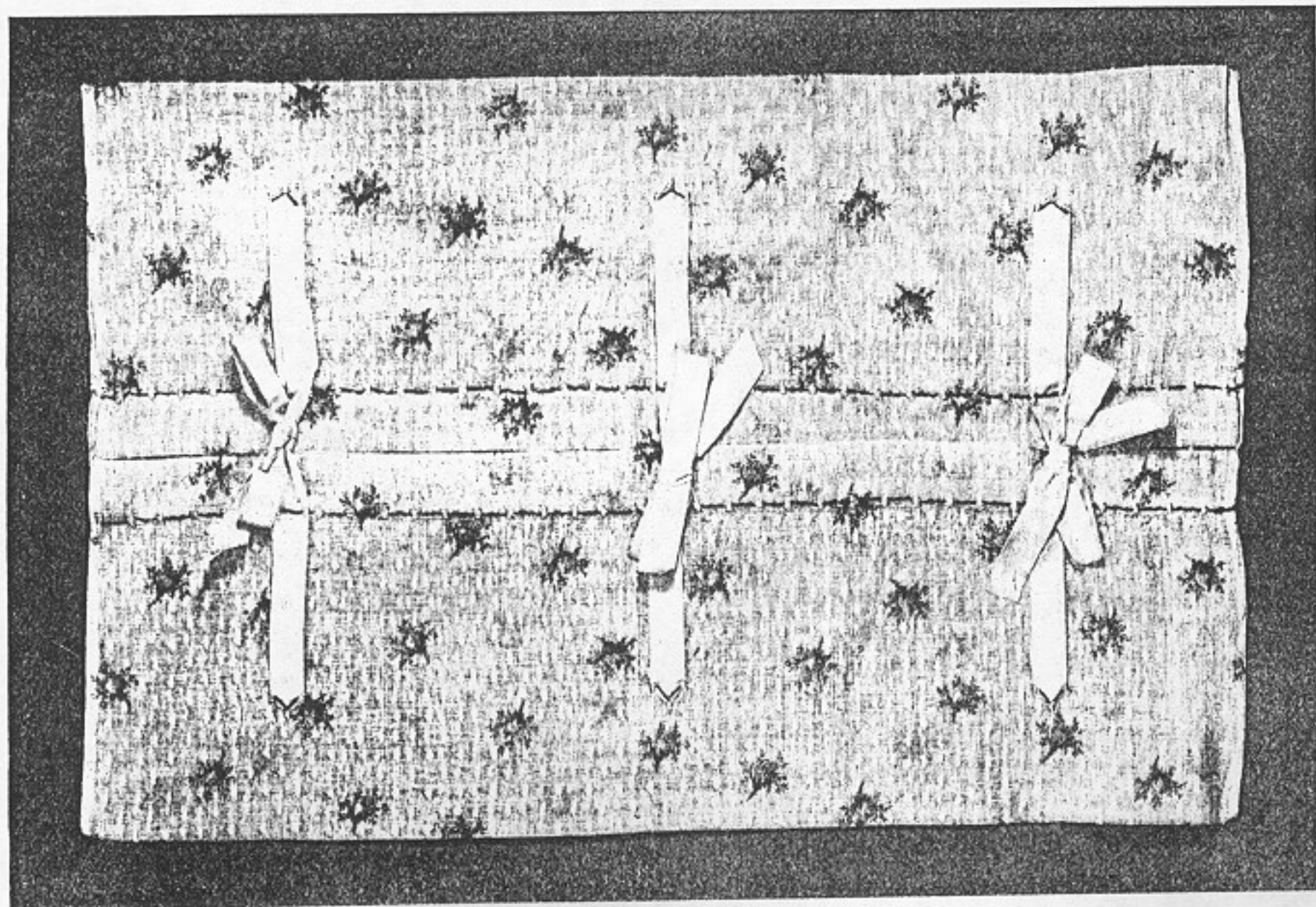
to meet any emergency. Needles and pins of all sizes must not be forgotten. Do not crowd the bag, but for repairing articles like gloves, a pair of the tiny "stork" are above price.



A CASE FOR BLOUSES. This is meant to hold two waists, but can be made to hold more by making the two pockets larger. For materials Dresden muslin of the dainty rosebud pattern is appropriate, but the pattern should be of larger units than when the same material is used for the smaller articles for travelers, such as the toothbrush holder described elsewhere. The muslin must be 31" long and 22" wide. Six pieces of $\frac{5}{8}$ " pink ribbon, each 15" long, will be needed for the ribbon fastenings. To make the case, first turn $1\frac{1}{4}$ " hems on each side or of such widths as will bring the dots on the edge of the hem. Fold over the ends to form pockets 7" deep on each end. Over-and-over the ends of the pockets. Attach the ribbons as in the diagram. Cover the row of dots in the muslin at the edge of the hem with pink twist or embroidery silk. Connect the dots with the Kensington outline stitch in green silk. This hem may be simply hemmed or hemstitched, or finished with a cat-stitch or feather-stitch. With three dots in pink silk fasten the pointed ends of the ribbon. Connect the dots with outline stitch in green. The case should be folded after packing, bring-

ing the two halves together. It could be adapted also to carrying a broader single garment, in which case it would be used without folding. A gift of two waists could be given in no prettier package, thus showing something of the giver's handiwork from the time the wrapping was undone to the moment when the waists were disclosed, perhaps bearing further evidence of the giver's skill in embroidery. Surely no more practical gift could be offered, for the shirt-waist is one of the utilities which defies the arrogance of fashion, and refuses to begone. On the contrary, it has made Dame Fashion its handmaid, and has called into its service her most delightful craft, that of the embroidered pattern. There are shirt-waists of low degree and of high, but in kitchen or reception room, on the lawn or street, they are always in good taste. What an adaptable garment! How did the housewife ever get along without that variety known as the "Johnnie Jones"?

It has been hinted that "mere man" has worn them in the guise of the summer shirt, and Postmaster Uncle Sam has come out "flat-footed" in defense of this summer comfort.



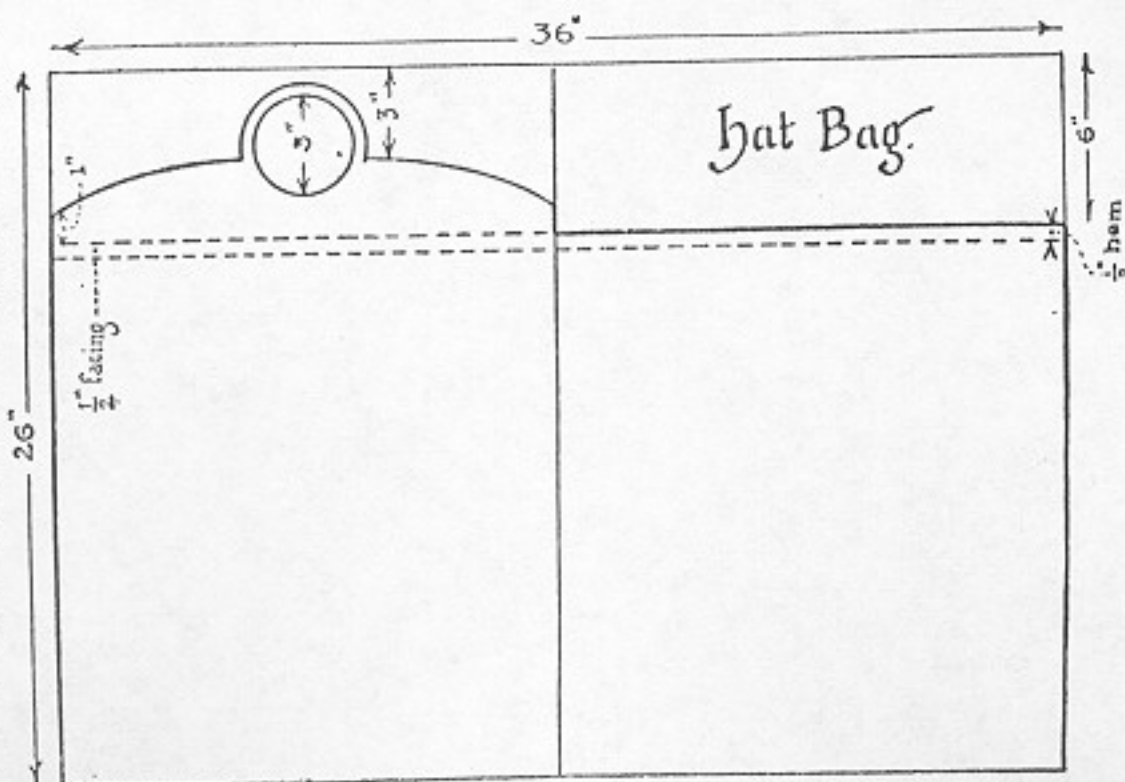


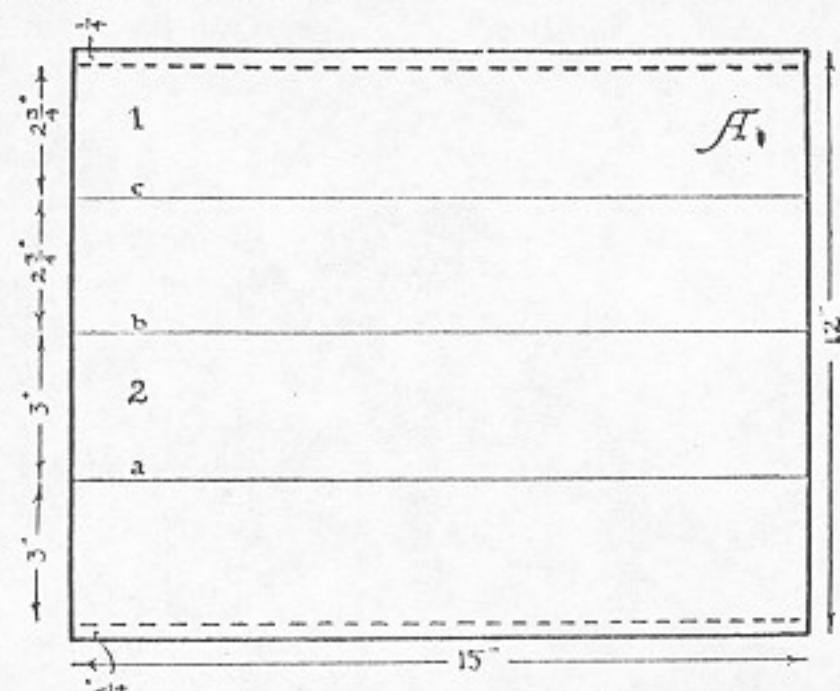
that this, the heavier material, may not be too bulky. Place the medallion. Finish with silk cord couched with the buff silk twist. Next, face the edge of the lap. On the edge of the lap couch the cord. A loop of cord in the lower center of the circle may be left to which a silk tassel or ball may be fastened. Finish the top of the other side of the bag with a $\frac{1}{2}$ " hem for the drawstrings. Provide for the drawstrings on the rest of the top with a $\frac{1}{2}$ " facing of silk. Use cord for drawstrings. These may be finished at the ends with tassels. This bag, with its materials of Oriental silk, and the circular medallion after the style of the Japanese, strongly suggests the handiwork of that nation of marvelous craftsmen. The circle is very like the family seal of the old time samurai aristocracy, which was employed judiciously as a decoration, and never lavishly. It was worn especially as a single spot of

A HAT BAG. For a woman's hat, and should be made of colors corresponding to the traveling suit. The bag shown herewith was made of India silk in green and buff. It requires one yard of green for the bag, 26" wide; a 6" square of the other color silk (or linen canvas) in buff; 4 yards of green silk cord, $\frac{1}{4}$ " in diameter; one skein fine green embroidery silk; two spools of buff silk twist. Sew the ends of the silk together in a French seam, making one side of the bag. Seam the bottom of the bag. Cut top like diagram. For the applied medallion a handsome initial or monogram is appropriate, to be done boldly in simple outline stitch, so as to be effective on a darned background. This one shows a stenciled pattern of a bird, suggestive of travel, after the Japanese. Cover the background of the medallion with green embroidery silk, over two threads, under two threads, alternating on next row. Before gathering, cut out triangles in the overlapping edges of the canvas,

decoration upon the outer silk garment of the male members of the family, and may be ranked with their famous two swords as a mark of the high birth of the wearer.

It vied with the "sword knot" in which the silken girdle-cord of the wearer was tied, as an index to the family line. The embroidering of it was an act of religious devotion for the worker.



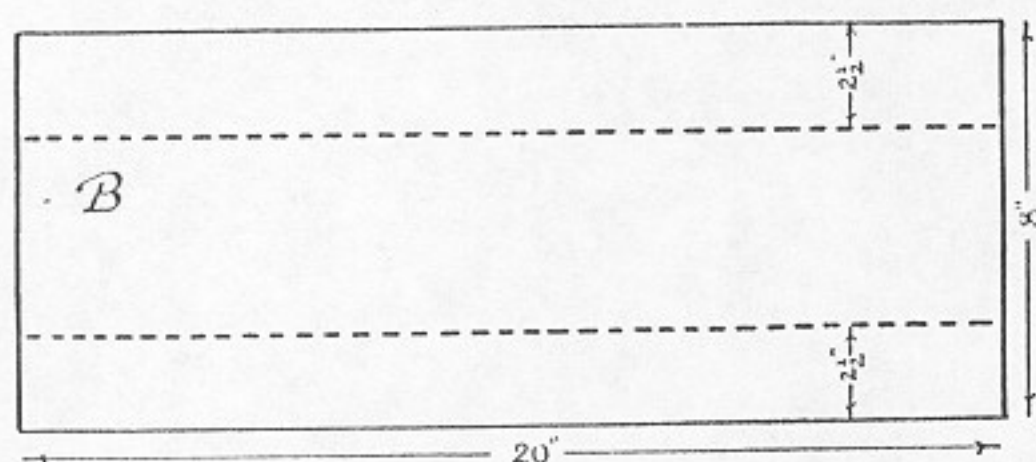
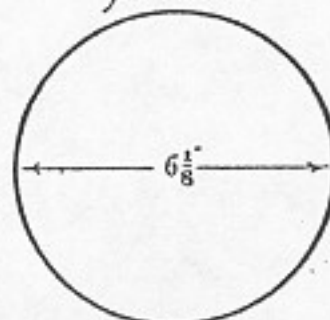


Collar Cases

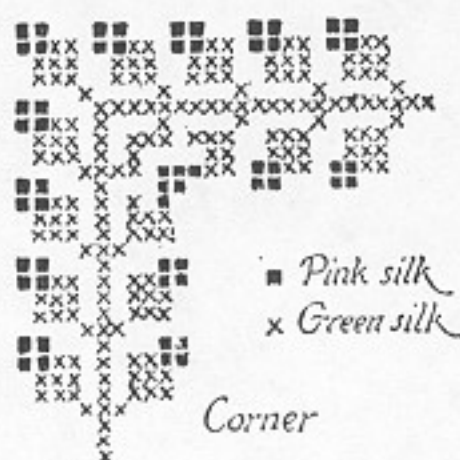
A. Turn-over collars

B. Stiff collars.

*Cardboard base
for case B*



Medallion



Corner

■ *Pink silk*
x *Green silk*



Corner

thread imported creamy white linen, 20" long and 8" wide; a circle of linen 7" in diameter; lining silk, old rose, same dimensions; two circles of cardboard 6 1/8" diameter; and one 21" long and 2 1/2" wide; twelve jade rings, 1 1/2" diameter, or brass, covered with crochet cotton; two yards of silk cord; four tassels. On the lower edge of the linen is a pattern stenciled in green and rose; cover one circle with it, adapting the stenciled pattern to it. Cover the other circle with lining silk and over-and-over the two together. Seam together the upright portion, line with silk, seaming upper edges on wrong side, turn and sew lower edges, folding together with a blind stitch. Over-and-over this to the circle on wrong side. Turn. Insert between lining and outside the 2 1/2" strip of cardboard, by ripping lining seam. Hold cardboard in place by stitching. Sew on the rings 2" from top. Run through them two silk cords of old rose, each 36" long, finished with four tassels.

To adjust draw strings, see

TWO COLLAR CASES. The materials for model A are white mercerized cotton, basket weave, 15" wide, 12" deep. It is lined with Persian lawn with an interlining of sheet wadding. One of light-weight cardboard is also used in spaces 1 and 2. Make the width of the case correspond with the size of the collars. Cut cloth of somewhat indefinite width to allow for adjusting the embroidered pattern, that the margin around the case may be the same. The pattern is a conventionalized rosebud in pink and green filo silk. If the material is too fine, baste on Penelope canvas. Stitch across the case at *a*, *b*, *c*, *d*, or feather-stitch with pink silk on the lining. To make Case B use a strip of round

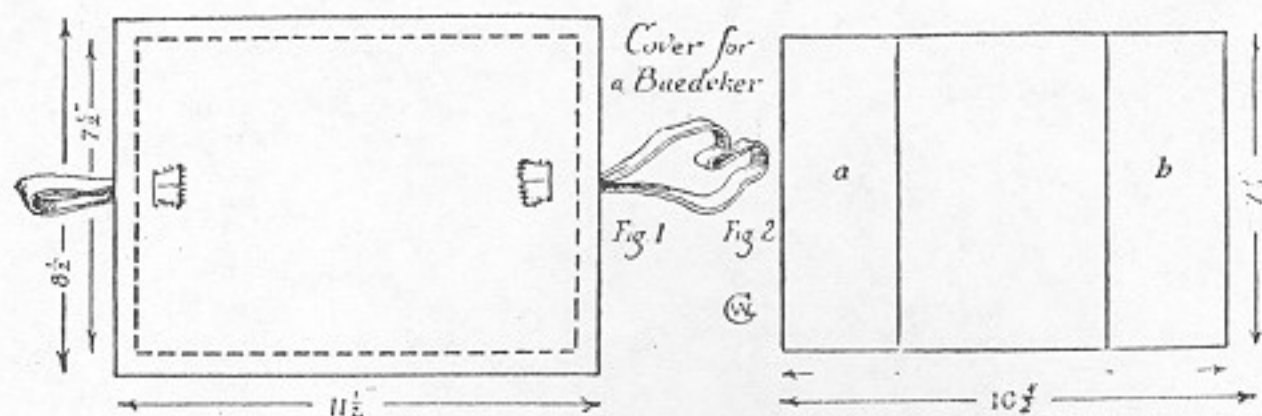
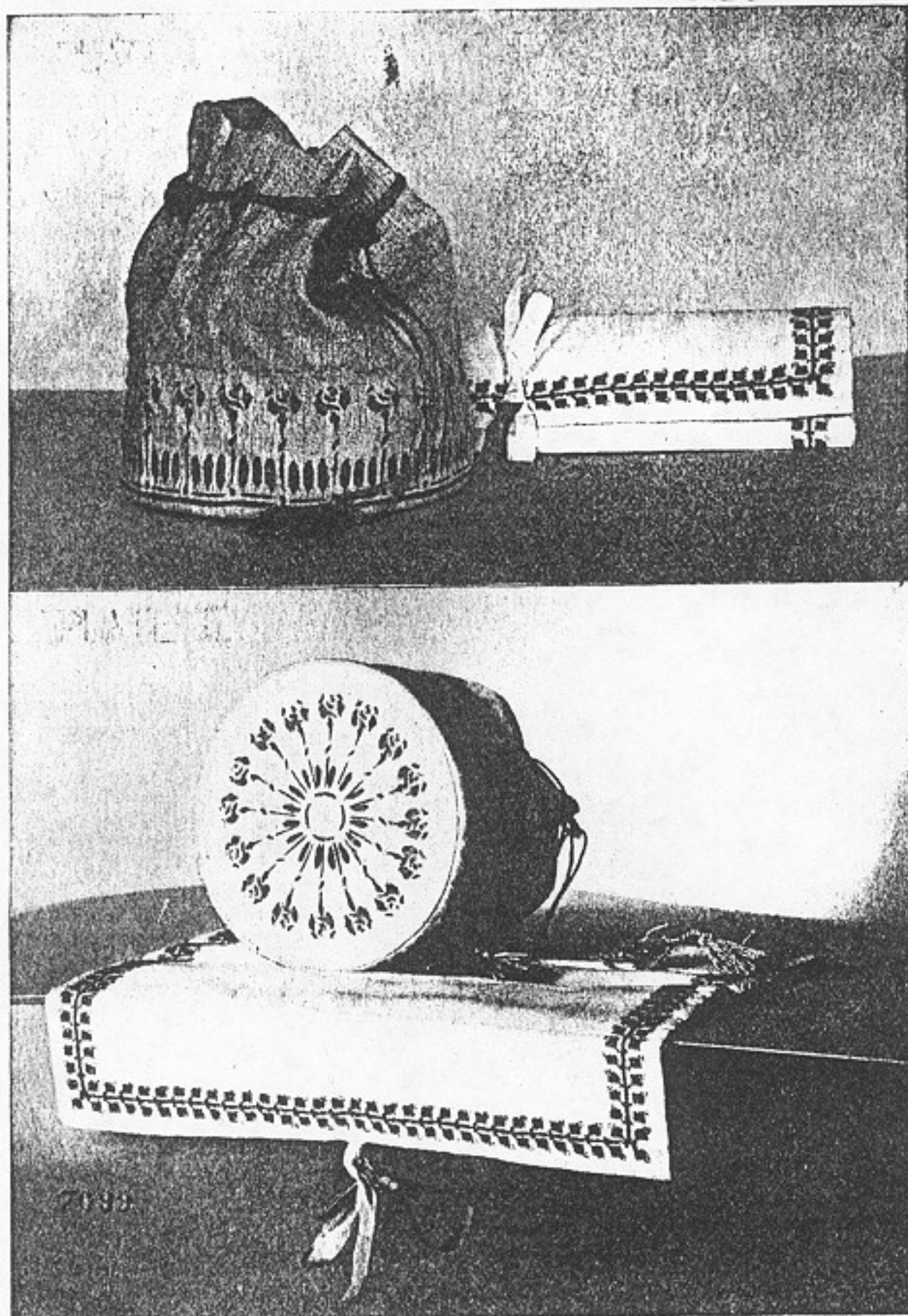
instructions for making Sponge Bag. To make cord and tassels use Asiatic Twisted Embroidery No. 2240. One skein makes one yard of cord. Two persons at opposite ends twist the silk until it readily kinks. Then fold the silk so that there are three strands, — three making a prettier cord than two. Hold the ends with great care till the strands are adjusted. Twist in the opposite direction and fold with three strands. The finished cases are shown on the next page. This simple article does not require intricate mental processes, but it does require a mind intent upon good, plain work, well performed. Without this, even the simplest things are unsatisfactory.

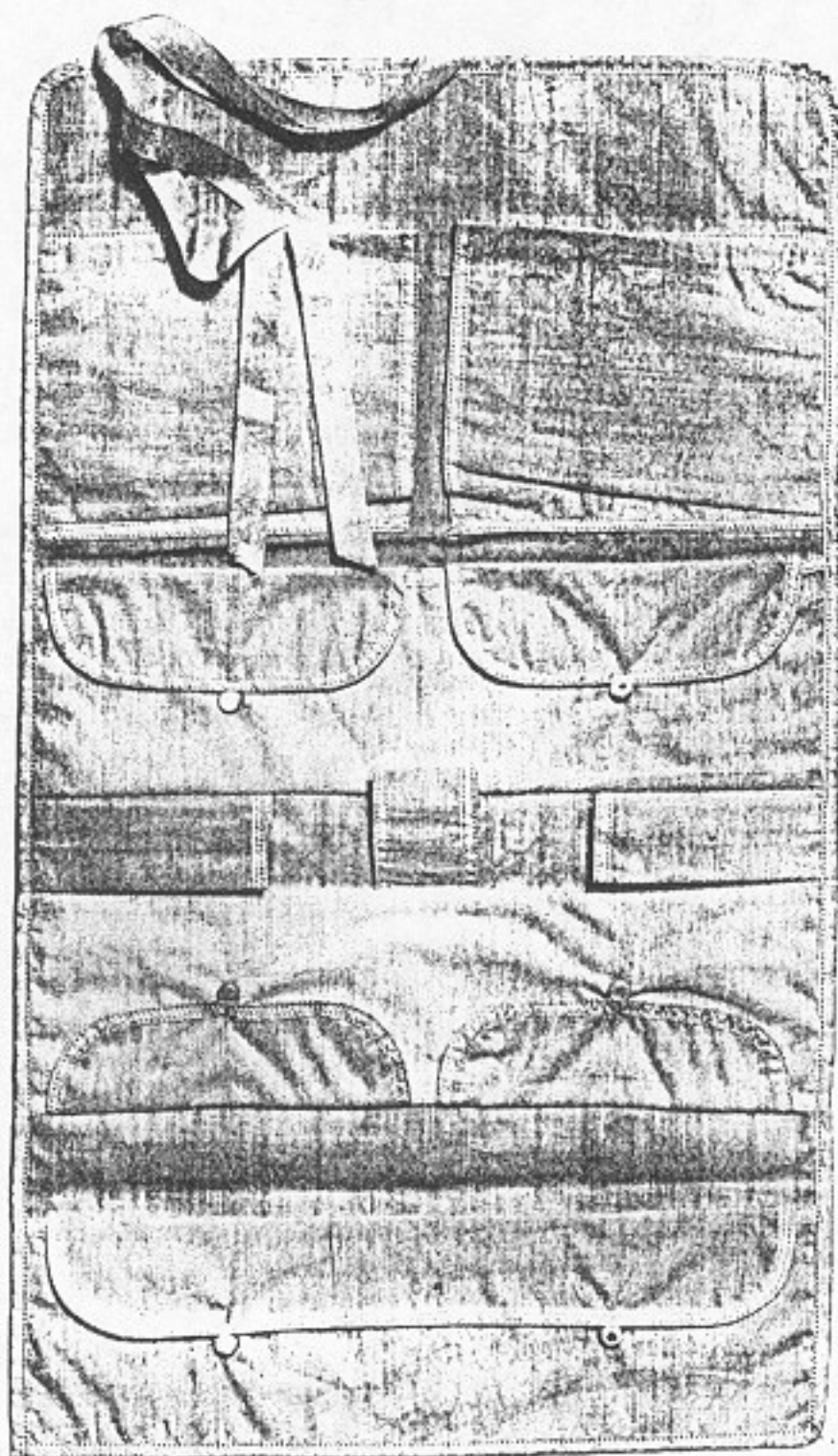
A GUIDEBOOK COVER. The material is heavy firm linen in the natural color, stenciled in two shades of green, harmonizing with a woman's traveling suit, or to suit the owner's taste. It will save many a ragged edge and bruised corner. Cut the canvas $11\frac{1}{2}$ " long and $8\frac{1}{2}$ " wide. Cut a similar piece for the lining. Cut two pockets $8\frac{1}{2}$ " long, $3\frac{1}{4}$ " wide; a strap 32 " long, $\frac{7}{8}$ " wide. Turn over edges of the outside cover, $\frac{1}{2}$ " deep. Cut out the corners. Press with hot iron. Turn in edges of strap, making it $\frac{7}{8}$ " wide, and stitch twice across. Cut slots as per diagram after basting a piece of linen underneath for strength and stitching each side of the prospective slot. Buttonhole-stitch the slot. Adjust the strap, leaving a loop of $2\frac{1}{2}$ " on one side, 6 " on the other, and a single strap extending across the inside of the cover. Line, cutting out the edges beneath the pockets. Hem one side of each pocket. Turn in edges and baste across the ends of the cover. Stitch around the cover $\frac{3}{16}$ " from the edge.

Going abroad without a guidebook is like visiting a picture gallery without a catalogue; in either case your information is not readily

digested, and is apt to remain somewhat jumbled in your mind. It is a good plan to follow the method of one traveler who always made

his own comment notes on the margin of his Baedeker and often drew tiny sketches to fix the place in his memory. What is true of the Baedeker in Europe is also true of the Baedeker or Sweetser in America. The book seems more your very own.

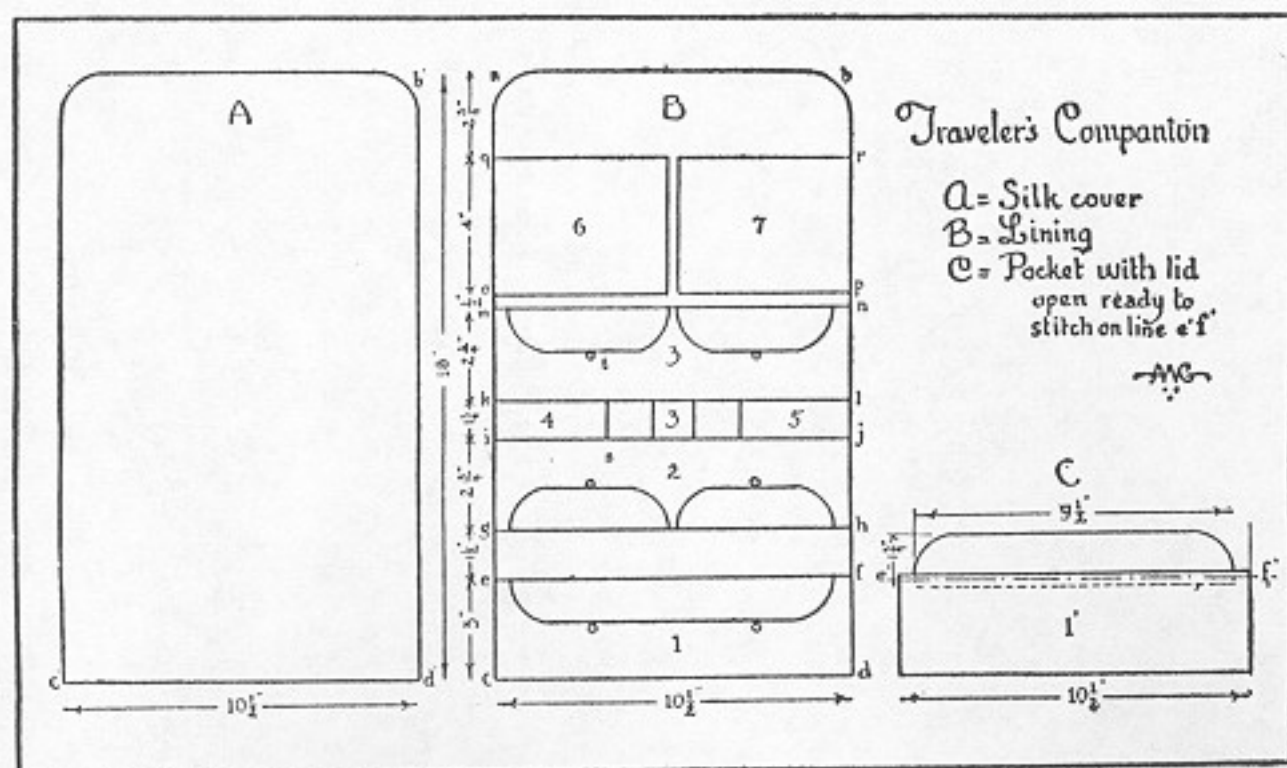


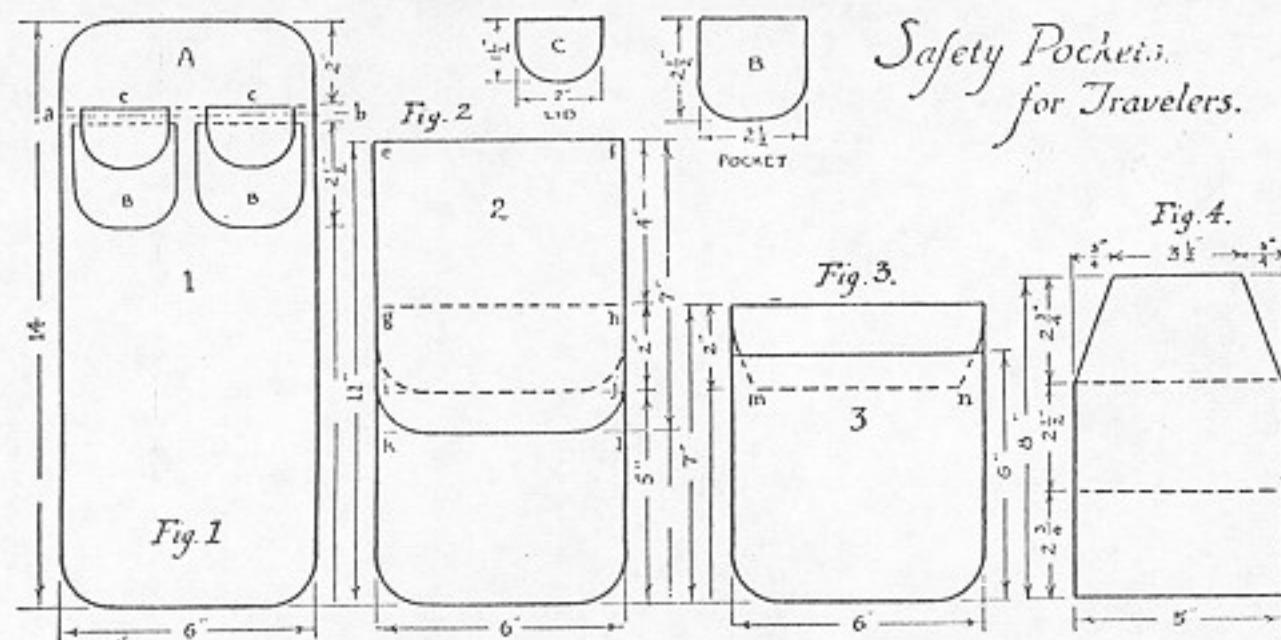


corresponds to *ef*, *gh*, *mn*, the horizontal opening of the pockets. Pockets 4, 5, 6, 7 have a vertical opening towards the center. Bind one side of pockets 4, 5. Baste binding on three sides of pockets 6, 7. Stitch the included side only. Bind the pocket lids on each side, except the straight one. Bind the longer sides of the strap. Indicate on the lining lines *ef*, *gh*, *ij*, *kl*, *mn*, *op*, *qr*. The figures on diagram B locate them. Arrange the lid of pocket 1 as in C. Stitch on line *ef*; $\frac{1}{4}$ " allowed for seam. Turn back to position. Adjust lids same way on pockets 2 and 3, two on each. Lay a box pleat in pockets 4 and 5, making the width $1\frac{3}{4}$ ". Adjust to the lining the opening at *st*, the sides extending $\frac{1}{4}$ " beyond lines *kl* and *is*.

In the same way adjust pocket 5, and the strap in center of the space at lower 3. Seam pocket 2 on line *ij*; pocket 3 on line *kl*. This stitching also fastens sides of pockets 4 and 5 and the ends of the strap. Lay box pleat in pockets 6, 7, reducing width to 4". Adjust on lining with vertical opening towards central line *xy*, sides on lines *op*, *qr*. Stitch the lines. Fasten loops of white silk elastic cord on the lids of the pockets, buttons on the pockets. Pockets 2 and 3 may be divided by vertical stitching along line *xy*. Fit the completed lining to the silk cover. Bind with ribbon. At *x* fasten $\frac{3}{4}$ yard of ribbon.

A TRAVELER'S COMPANION. Cut plaided silk cover $10\frac{1}{2}" \times 18"$. Stork sheeting lining, $10\frac{1}{2}" \times 18"$. Round two corners of cover and lining. Cut pockets 1, 2, 3, $10\frac{1}{2}"$; pockets 4 and 5, $3\frac{1}{4}" \times 3\frac{1}{4}"$; pockets 6 and 7, $5" \times 5"$. Cut one pocket lid, $9\frac{1}{2}" \times 1\frac{3}{4}"$; cut four pocket lids, $3\frac{3}{4}" \times 1\frac{3}{4}"$; one strap, $3" \times 1\frac{1}{4}"$. Stitch white binding ribbon on one side of pockets 1, 2, 3. The bound edge



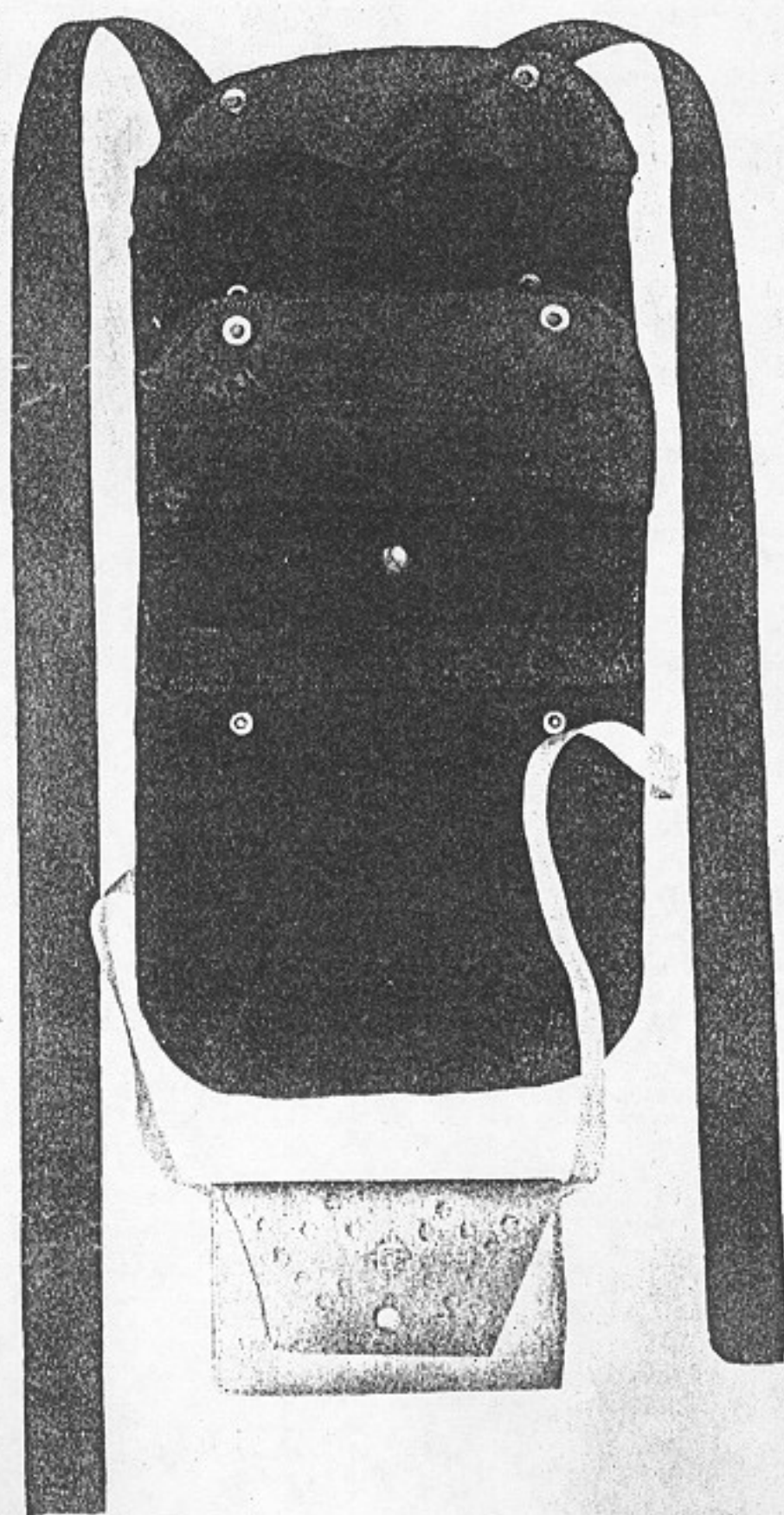


*Safety Pockets
for Travelers.*

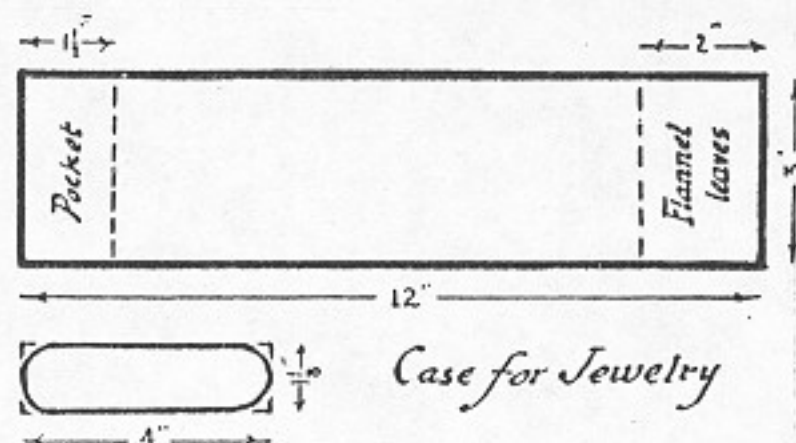
with one button. Attach $\frac{3}{4}$ yard white wash ribbon to the upper corners.

The ball and socket fasteners can be bought and adjusted at almost any glove store. Such a safety pocket as the large one can be used to carry securely a variety of things, although meant especially for jewelry. Take this pocket on a journey and you will find new uses for its pockets.

SAFETY POCKETS FOR TRAVELERS. The first of leather, the second of linen. Cut a strip of kid 14" long and 6" wide. Round the corners. Line with silk, turning edges in. Stitch around lid A. Cut two pockets, B, $2\frac{1}{2}$ " square, rounding lower corners, and stitch as shown. Cut pocket lids, C, $1\frac{1}{2}$ " deep and 2" wide. Turn lid A on dotted line. Stitch on *ab*, including lids C. Cut strip of green taffeta silk (2). Baste on strip of kid *ghij*. Cut a strip of kid 7" $\times$ 6". Line part corresponding to *ghkl* with silk and stitch edges. Adjust this to silk (2), upper edges corresponding. Stitch on *gh*. Cut silk strip 7" $\times$ 6" (3). Apply kid strip 6" $\times$ 2" to upper part, cut as at *mn*, stitch, and place 3 upon 2, lower ends corresponding. Stitch sides and base, making inside pocket. Cut strip of kid 6" $\times$ 6". Line with silk, turn in edges. Stitch across top. Apply to 3, lower edges corresponding. Stitch 1, 2, 3, together. When completed, there is the long pocket, length of Fig. 2; middle pocket, length of Fig. 3, its lid buttoning on narrow kid on *gh*; and outside pocket, with *ghlk* for a lid. Buttons should be brown, and fasteners are ball and socket, glove style, or dress style sewed on. For pocket No. 2 cut a strip of butcher's linen 8" long and 5" wide. Cut off the corners of the lid as shown in the diagram, Fig. 4; turn in the edges on all sides; line with thin linen or Persian lawn; stitch; fold to make a pocket $2\frac{1}{2}$ " deep. Ornament the lid with large dots heavily padded. In the center cut out the cloth and fill in with lace stitches for the medallion. Fasten



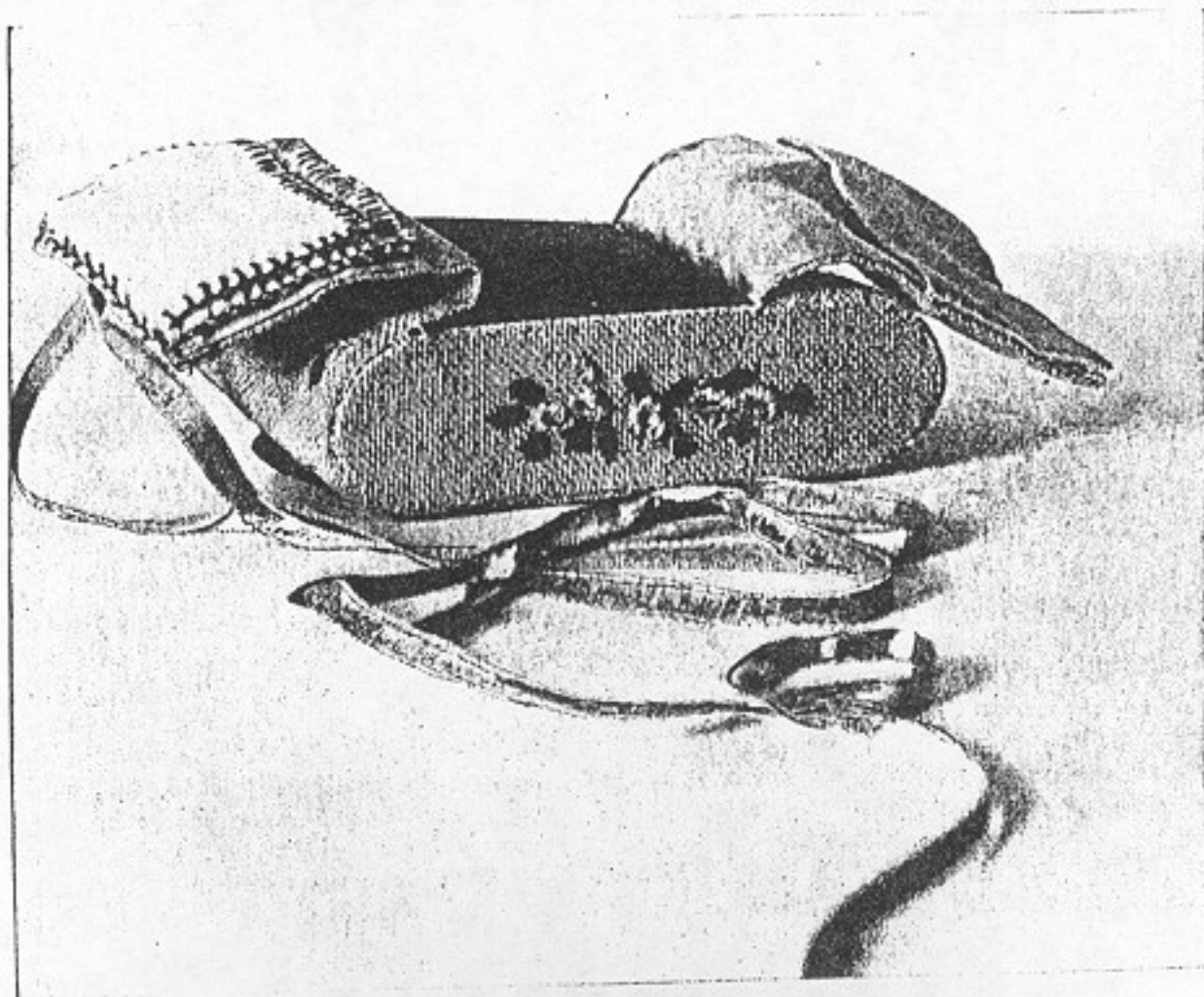
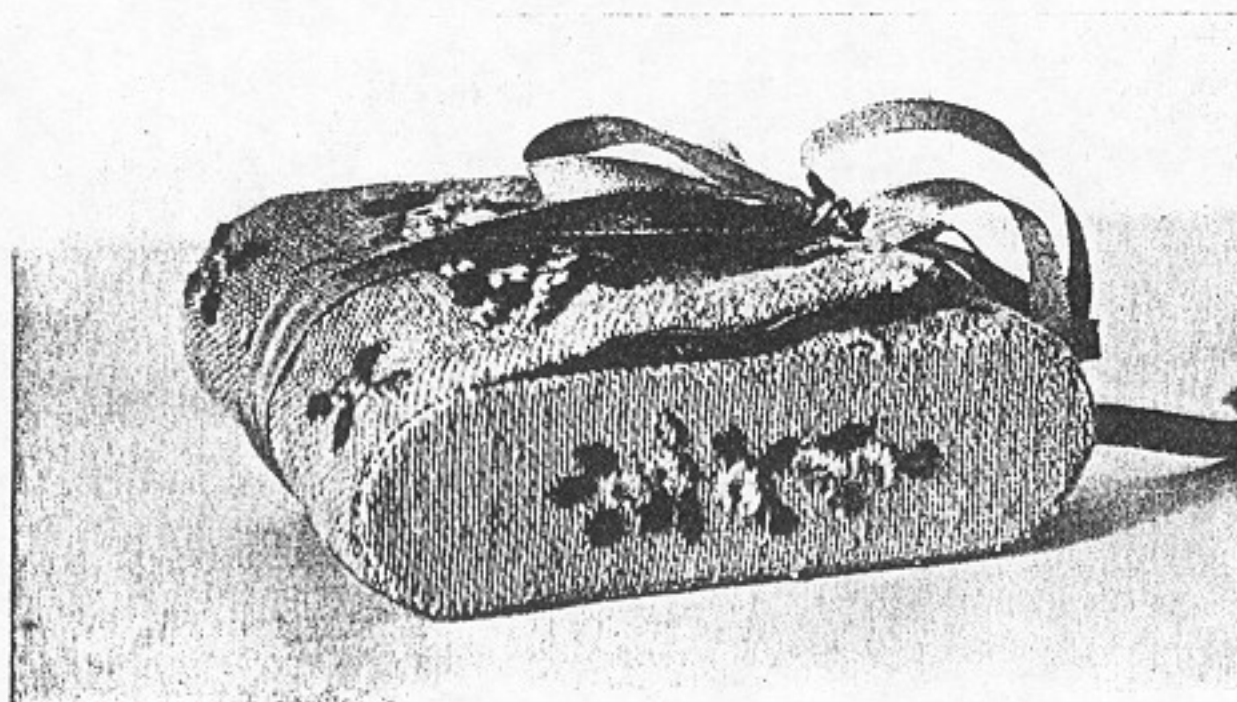
A CASE FOR JEWELRY. This may be made a very beautiful gift. Materials: Two pieces of cardboard $4" \times 1\frac{1}{8}"$. Round the corners as in the diagram. One strip of gray linen, canvas weave, $12" \times 3"$. One skein of old rose filo silk; three skeins of yellow-green silk, corresponding in value to the old rose, one lighter, one darker. The mercerized embroidery cottons are in some ways more desirable than the silks, being more in harmony with the material. Embroider upon one end a conventional rose-tree, with sprays scattered over the rest, or use any other design. Embroider the linen that



covers the cardboard in a similar way. Cover the cardboard and line with old rose silk. Line the long strip, making a pocket $1\frac{1}{2}"$ deep at one end. Buttonhole-stitch the edges of flannel (see diagram) with shades of green, and sew on the other end to be used for collar pins. Fasten the middle of the strip to the middle of the stiffened sides. Sew on over and over, leaving an opening of two inches on the opposite side.

Attach one yard of ribbon at its middle point to the middle of the strip, leaving the heavily embroidered end uppermost. When completed, this Jewelry Case has a most attractive appearance, its shape suggesting mystery as to contents. If done with the materials named, and in the design suggested, its outer surface will strongly suggest the beaded bags of the nineteenth century. What wonders of needlework were those, often embroidered all over in one solid surface of beading!

It would be well if we could again find time to make such things, by the same leisurely methods that our mothers used. For, admitting that we would lose valuable time, we should doubtless live longer.



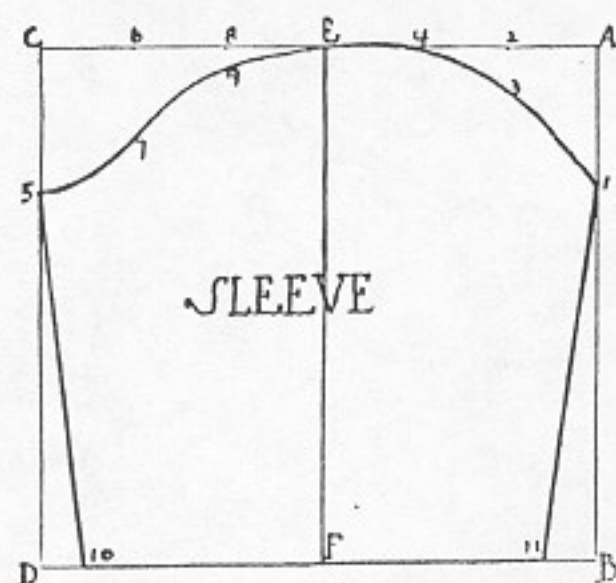


FIG. 2

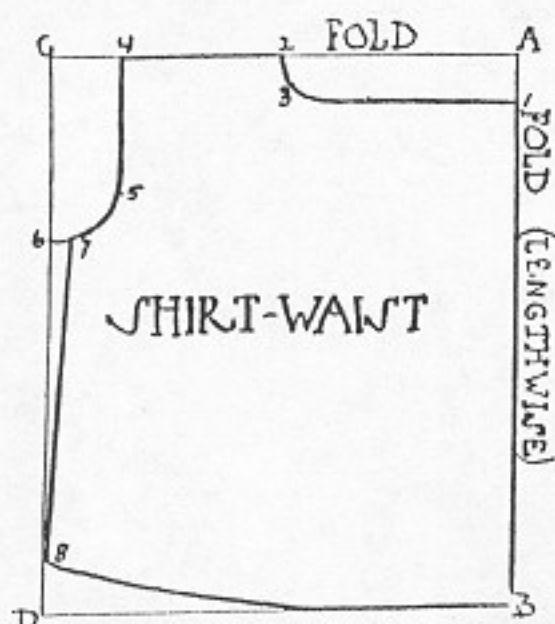


FIG. 1

PLATE I

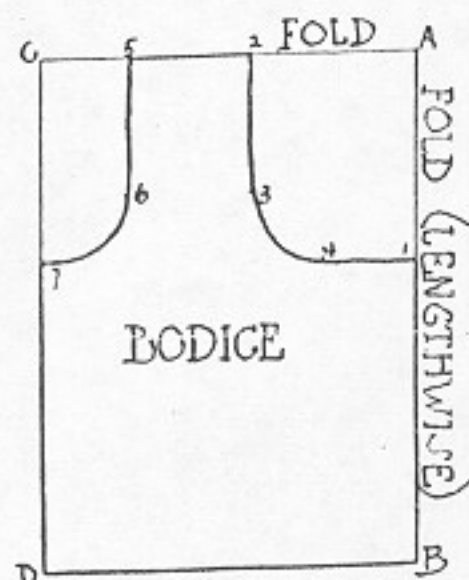


FIG. 3

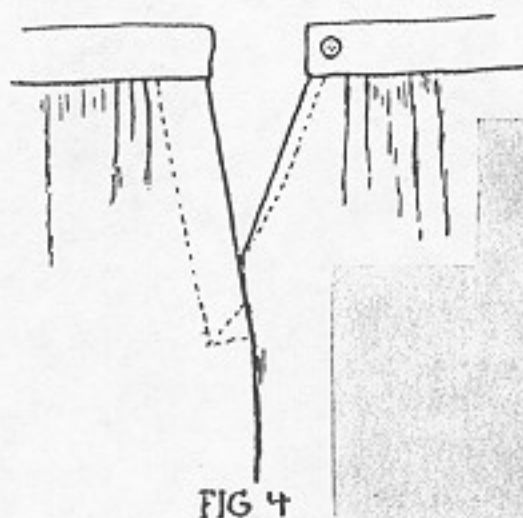


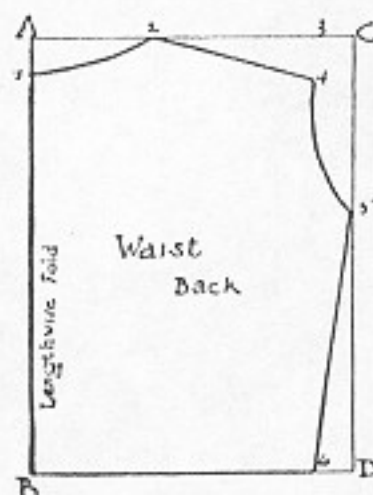
FIG. 4

COSTUMES FOR FOLK DANCES or for a doll. Point 1 is $\frac{1}{2}$ " from A. Point 2, $2\frac{1}{2}$ " from A. Point 3, $\frac{1}{2}$ " from 2. Draw curve from 1 through 3 to 2. Point 4 is $1\frac{3}{4}$ " from 2. Point 5 is $1\frac{1}{2}$ " from 4. Point 6 is 2" from C. Draw curve from 4, through 5 to 6. Point 7 is $\frac{1}{4}$ " from 6. Point 8 is $3\frac{1}{2}$ " from 6. Draw curve from 8 to B. Open pattern and cut one fold from 1 to B, for opening at back. Cut material folded same as pattern. Hem back edges. Gather neck from point 3 on each side to center back and front, and bind. French-seam under arm. Hem bottom. Locate waist line in back, and tack center of tape, to tie about waist, to center back. For a pattern for twelve-year-old girl, take paper $30" \times 36"$, multiplying all numbers by 3. For Sleeve Pattern: Use paper $6" \times 5\frac{1}{2}"$. Place with short edges vertical and letter corners as in chart. Calculate measurements by spacing from Fig. 1. For Bodice, paper must be $8" \times 12"$. For Apron, $9" \times 11"$, and for apron for child, one width of $36"$ cloth. For Skirt, cut goods $11"$ lengthwise and

$27"$ wide. Hem $1"$ at bottom. Placket opening at center back, $3"$. Hem placket narrow one side, sloped to point, $\frac{1}{2}"$ hem on other, tacking wide over narrow at bottom. Gather each side from front center, two rows, to hems. Place in band cut lengthwise, $1\frac{1}{2}"$ wide. For child, use about $3\frac{1}{2}$ breadths of material $31"$ wide. Cut long enough to reach nearly to ankles, allowing hem.



ENGLISH PEASANT COSTUME for doll or child. Fig. 1, Front of Waist: Paper, $8'' \times 6''$. A-B is front edge of surplice front. Points: 1 is $3''$ from A; 2, $4\frac{1}{4}''$ from A; 3, $1\frac{1}{2}''$ from 2; 4, $1''$ from 3; 5, $\frac{1}{2}$ distance 3 to 4; 6, $\frac{1}{4}''$ from 5; 7, $3\frac{1}{2}''$ from C. Line A-1, shoulder. Line 3-7, under arm. Curve 1-4-3 front of armhole. In cutting, fold selvages together, place line A-B even with selvage, allowing for hem. Shirr shoulder to fit shoulder of back. Back of Waist, Fig. 2: paper, $3''$ long, $4''$ wide. Fold on center, making oblong $3''$ long and $2''$ wide. Points: 1 is $\frac{1}{2}''$ from A; 2, $1\frac{1}{2}''$ from A; 3, $3\frac{1}{2}''$ from A; 4, $1\frac{1}{2}''$ from 3; 5, $2\frac{1}{4}''$ from C; 6, $\frac{1}{2}''$ from



PATTERNS FOR 19" DOLL
SCALE $\frac{1}{4}'' = 1''$

FIG 1.

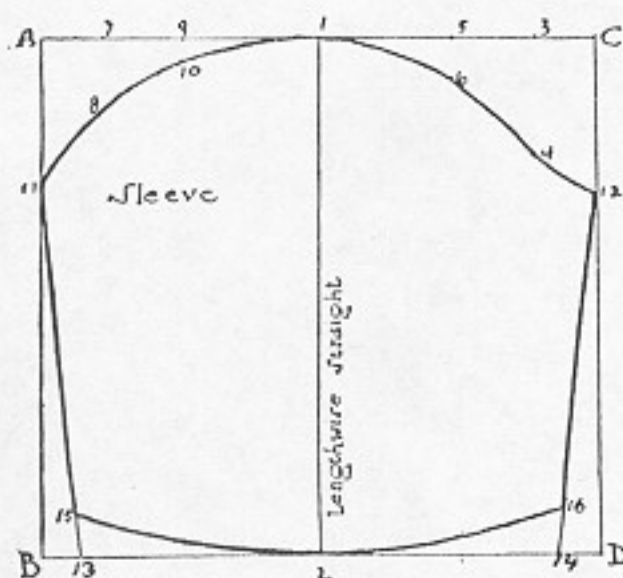
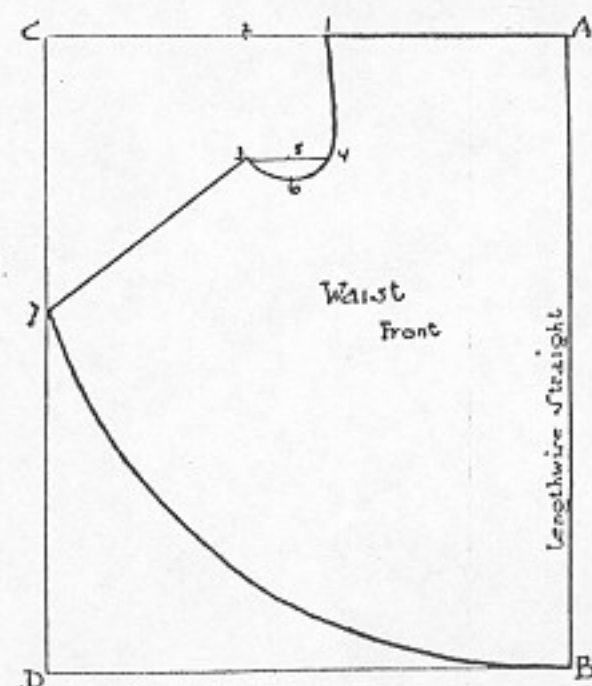


FIG 4

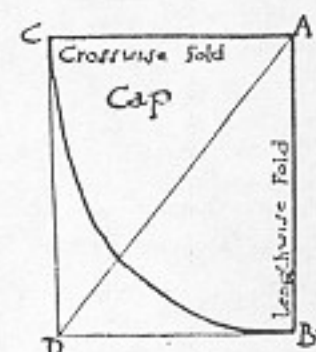
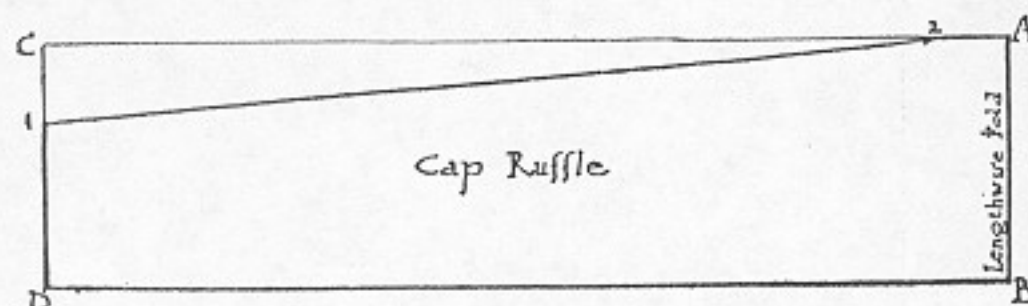


FIG 5



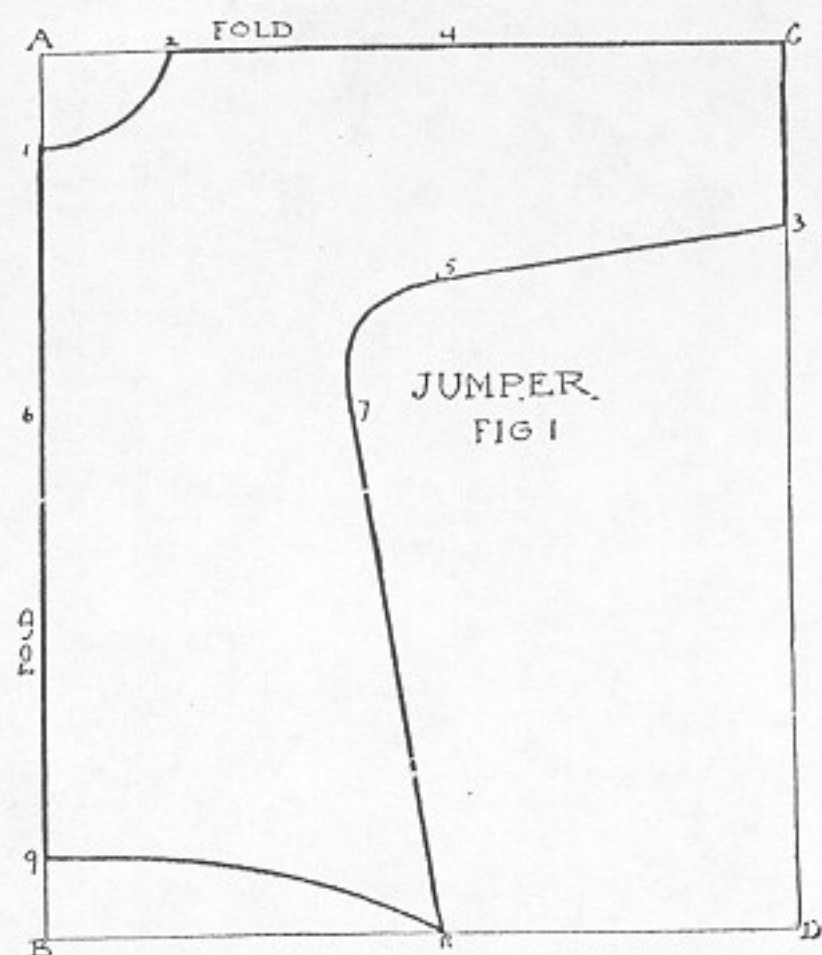
D. Line 1-B center of back; 2-4, shoulder; 5-6, under-arm; 1-2, neck; 4-5, back of armhole. To cut, place center of back on lengthwise fold of cloth. Face back of neck with bias strip of cloth. From the dimensions of these two figures, your judgment will enable you to space off for the Sleeve, Cap, and Cap-ruffle patterns. Sleeve is gathered into deep cuff and shirred halfway down. Its pattern is $6\frac{1}{2}'' \times 7''$. That of the Cap, $7'' \times 6''$. Of the Cap-ruffle, $12'' \times 1\frac{1}{2}''$. Cap crown is gathered to a narrow tape. Line 1-2-A of Ruffle is shirred to fit head. Hem $\frac{1}{2}''$ on edge B-D. Trim with ribbon and bow. A three-cornered kerchief of soft white material may be worn inside the neck, the surpliced fronts crossing over the kerchief.



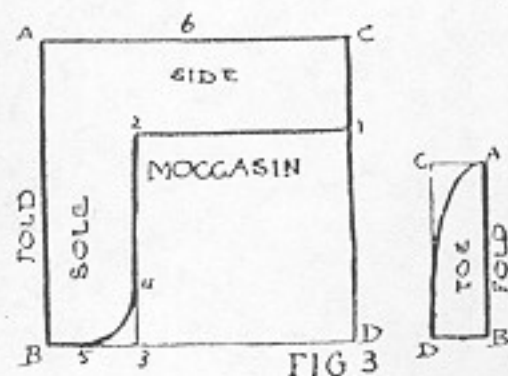
AN INDIAN DRESS FOR A DOLL. For Jumper: Take paper $17" \times 20"$, folding lengthwise and crosswise, and marking lengthwise fold A, B, and edges C, D. Points on diagram are: 1, distant $1"$ from A; 2, $1\frac{1}{2}"$ from A; 3, $2"$ from C; 4, $4\frac{1}{2}"$ from A; 5, $2\frac{1}{2}"$ from 4; 6, $4"$ from A; 7, $3\frac{1}{2}"$ from 6; 8, $4\frac{1}{2}"$ from B; 9, $1"$ from B. Curve for neck from 1 to 2. Curve for bottom from 8 to 9. Fringe sleeve from C to 3. Fringe bottom from 9 to 8. The garment may be made longer if necessary.

For Trousers: Paper, $8" \times 10"$. Fold lengthwise, mark fold A, B, edges, C, D. Point C is center of back. Point 1 is $1"$ from C. Point 1 is center of front. Point 2 is $5"$ from C. Point 3 is $1"$ from D. Curve from 2 to 3 for inside of leg. Fringe bottom of trousers.

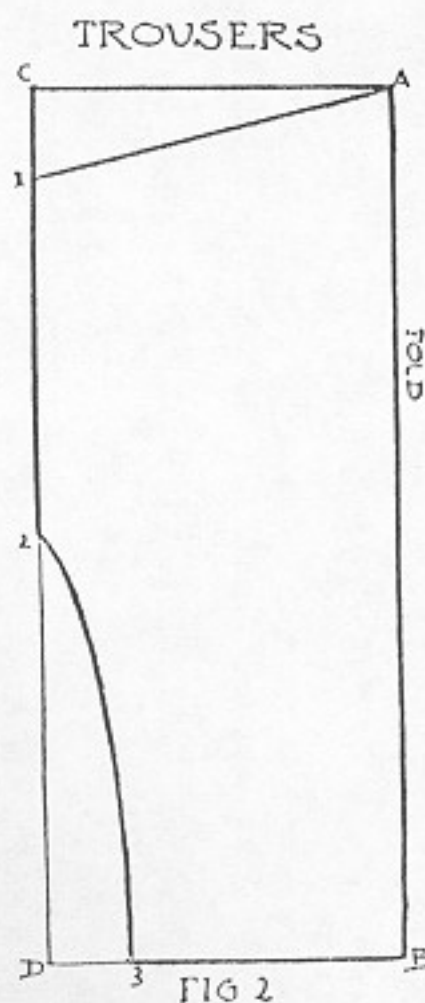
For Moccasins: Paper $7" \times 3\frac{1}{2}"$. Fold into square, mark fold A, B, edges C, D. Point 1 is $1"$ from C; 2 is $1"$ from line A, C and A, B;



PATTERNS FOR 19" DOLL
SCALE $\frac{1}{2}'' = 1$



BEH.



3 is $1"$ from B; 4, $\frac{1}{2}"$ from 3; 5, $\frac{1}{2}"$ from 3. Curve from 4 to 5 for heel. Point 6 is $1\frac{1}{2}"$ from A. Gather from A to 6. For the Toe: Paper, $2" \times 1"$. Fold lengthwise and mark as before. Curve from A to D for toe. In making, place A of sole to A of toe, and gather fullness around point of toe. Edges C-1 are seamed together and placed at B of sole, and sewed around sole. Toe portion may be opened from B towards A, and tied. For child's size increase by three except for moccasins.



GERMAN PEASANT GIRL'S COSTUME. Waist: Use for front pattern paper, $7\frac{1}{2}'' \times 6\frac{1}{2}''$. Points of diagram: 1 is from A, $2\frac{3}{4}''$; 2 from A, $1\frac{1}{2}''$; 3 from A, $4\frac{1}{2}''$; 4 from 3, $1\frac{1}{2}''$; 5 is $\frac{1}{2}$ of line 4-2; 6 from 5 is $\frac{1}{4}''$. Armhole curve is 1-2-6-4. Point 7 is from C, $4\frac{1}{2}''$. Draw line 4-7, curve inside for under-arm seam. For Back: paper, $6\frac{3}{4}'' \times 3\frac{1}{4}''$. Points: 1 is from A, $1''$; 2 from A, $1\frac{1}{4}''$. Draw back of neck 1-2. Point 3 is from C, $1''$. Draw shoulder line 2-3, cutting off at 4, which is from 2, $2''$. Draw curve 4-5 armhole. Point 6 is from D, $\frac{1}{4}''$. Draw curve 5-6, under-arm seam. Sleeve: paper, $7\frac{1}{2}'' \times 7''$.

Draw diameters E-F and G-H. E, highest point of upper sleeve, F, lowest part of curve at hand. Points: 1 from A is $1\frac{3}{4}''$; 2 from C, $1\frac{3}{4}''$; 3 from A, $\frac{1}{2}''$; 4 from 3, $1\frac{1}{2}''$; 5 from A, $1''$; 6 from 5, $1''$; 7 from C, $\frac{1}{2}''$; 8 from 7, $1\frac{1}{4}''$; 9 from C, $1''$; 10 from 9, $\frac{3}{4}''$. Draw curve top of sleeve. Point 11 from D is $\frac{3}{4}''$; 12 from B, $\frac{3}{4}''$. Draw curve bottom of sleeve. Point 13 from G is $\frac{1}{2}''$; 14 from H, $\frac{1}{2}''$. Draw inside seam of sleeve. Bodice: paper, $6'' \times 5\frac{3}{4}''$. Points: 1 from A is $3\frac{1}{4}''$; 2 from A, $2\frac{1}{2}''$. Draw curve neck front. Point 3 from C is $1\frac{1}{4}''$; 4 from C, $2''$. Draw curve back of neck. Point 5 is from A, $3\frac{1}{4}''$; 6 from 5, $\frac{1}{2}''$; 7 from 5, $3\frac{3}{4}''$; 8 from 7, $1\frac{1}{2}''$; 9 from 8, $1''$; 10 from 8, $1''$. Materials: cheesecloth, plaid gingham, black silk, and strips of scrim, embroidered. Bodice laces with red cord. The apron is embroidered with bands worked in red on white scrim.

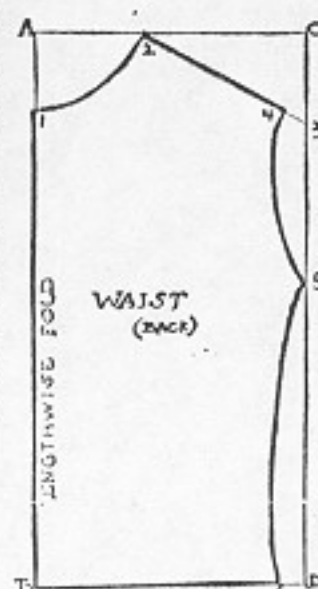


FIG 2

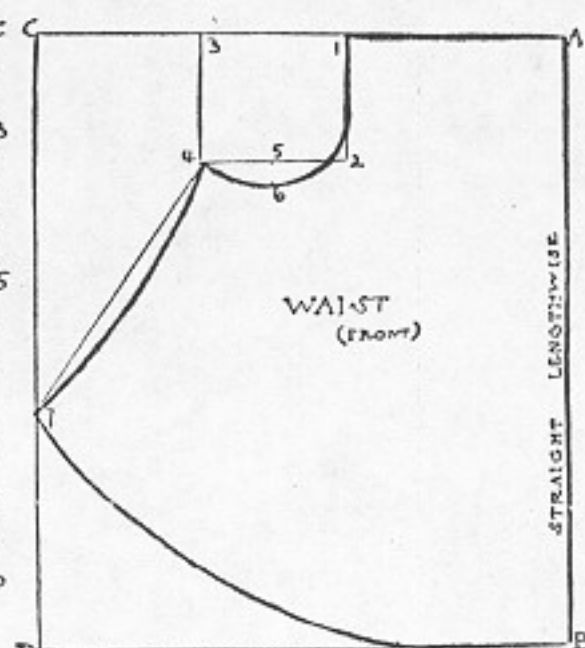


FIG 1

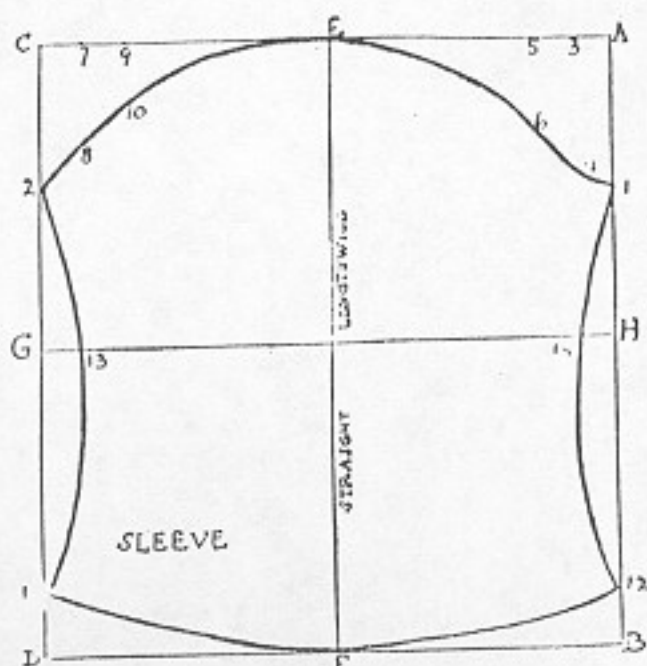


FIG 3

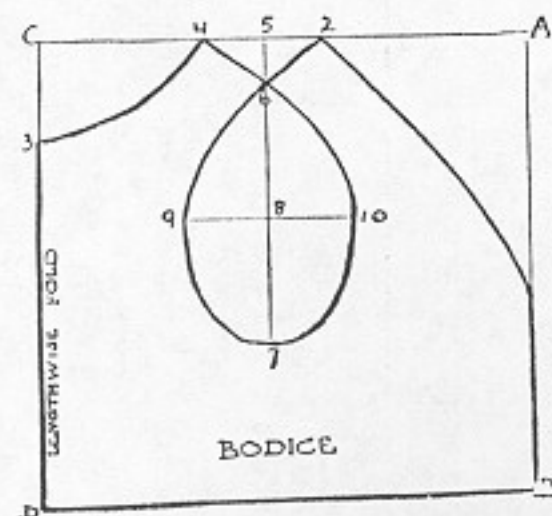


FIG 4

PATTERNS FOR 19" DOLL
SCALE $\frac{1}{4}'' = 1''$

A DRESS FOR A COLONIAL DAME; and no daintier costume is conceivable for a little American girl, or her dolly, for that matter. Making this dress will teach a little lesson in patriotic history. It was worn by our grandmothers when they were the belles of the eighteenth century and looked eagerly forward, as we do, to the coming party or reception. The stately dance offered just the chance to wear such a gown becomingly, with its prim waist and full skirt, never meant to whirl out from the dancer, but to rise and droop gracefully as she curtsied in the minuet.

"How she held her pretty head,
How her dainty skirts she spread,
Turning out her little toes,
How she slowly leaned and rose,
Long ago."

There was not then the daring audacity which impelled one damsel or another to depart from established custom in dress; most of the gowns for an ordinary party were patterned more or less alike in our eighteenth century colonial period, but this was offset by great variety in material and color. The graceful plait at the back of the neck, sweeping sheer down to unite with the train, and named for the painter Watteau, was a feature usually present. And if the occasion happened to be one of unusual festivity, she might wear the full gown of the sweet shepherdesses that he so loved to paint, with a full pannier overskirt effect as well as the plait. At the first inauguration ball, when the adored Washington had been made the first president of our land, records tell us that his costume was "a full suit of black velvet, with long black silk stockings, white vest, silver knee and shoe buckles, the hair being powdered and gathered together at the back in a black silk bag, tied with a bow of black ribbon. He wore a light dress sword, with a richly ornamented hilt, and often carried in his hand a cocked hat decorated with the American cockade." And it is added that "the collection of ladies at this ball was numerous and brilliant, and they were dressed with consummate taste and elegance."

The costume: Waist front paper pattern, $5\frac{3}{4}'' \times 5''$. A-B and C-D long way of paper. Points: 1 is from A, $1\frac{1}{4}''$; 2 from 1, $2''$. Draw

front, E to B. Point 3 is from C, $1\frac{1}{4}''$; 4 from 3, $2\frac{3}{4}''$; 5 from 3, $1\frac{1}{2}''$. Shoulder from E to 5. Point 6 is from C, $2''$; 7 from 6, $\frac{3}{4}''$; 8 from 7, $\frac{5}{8}''$; 9 from 7, $1\frac{1}{2}''$. Armscye, 5-9-4-8. Point 10 is from D, $\frac{3}{8}''$. Curve under arm, 8-10. Back: paper, $4\frac{3}{4}'' \times 2\frac{1}{2}''$. Points: 1 is from A, $\frac{3}{8}''$; 2 from A, $\frac{3}{4}''$. Draw neck curve. 3 is from C, $\frac{3}{4}''$. Draw shoulder 2-3. Four is from



C, $2\frac{1}{4}''$; 5 is from 4, $\frac{1}{4}''$. Draw back armscye. Six is from D, $\frac{3}{4}''$. Curve 5-6 is under-arm seam. Vest: paper, $3\frac{1}{2}'' \times 1\frac{1}{4}''$. Point 1 is $1\frac{1}{2}''$ from B. Sleeve: paper, $5'' \times 5\frac{1}{4}''$. Points: 1 is from A, $1\frac{3}{4}''$; 2 from C, $1\frac{3}{4}''$; 3 from A, $1\frac{1}{2}''$; 4 from 3, $1\frac{1}{2}''$; 5 from A, $1''$; 6 from 5, $1''$; 7 from A, $1\frac{1}{2}''$; 8 from 7, $1\frac{1}{2}''$; 9 from C, $1\frac{1}{2}''$; 10 from 9, $\frac{3}{4}''$; 11 from C, $1''$; 12 from 11, $\frac{3}{8}''$. Draw top sleeve curve 2-10-12-E-8-6-4-1. Point 13 from B is $1\frac{1}{2}''$; 14 from D, $1\frac{1}{2}''$; 15 from 13, $1\frac{1}{4}''$; 16 from 14, $1\frac{1}{4}''$. Draw bottom curve of sleeve 16-F-15. Be careful to make a good curve.

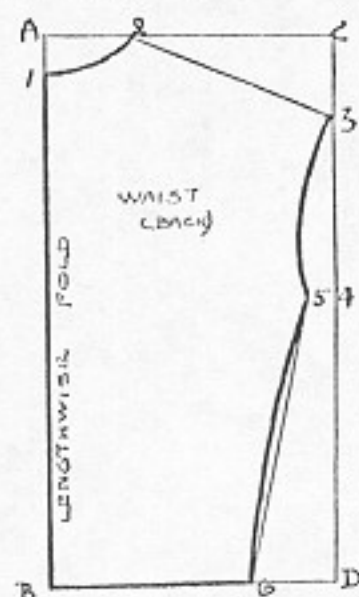


FIG 2

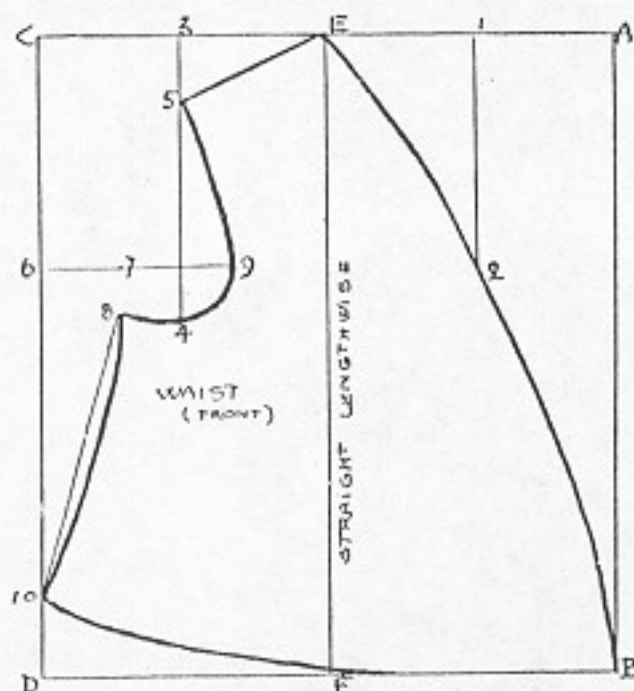


FIG 1

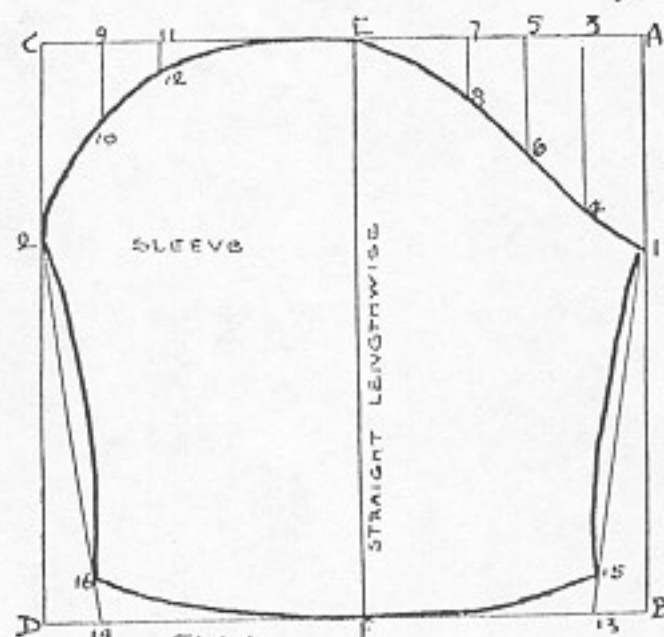


FIG 4

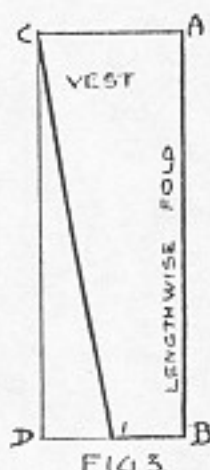
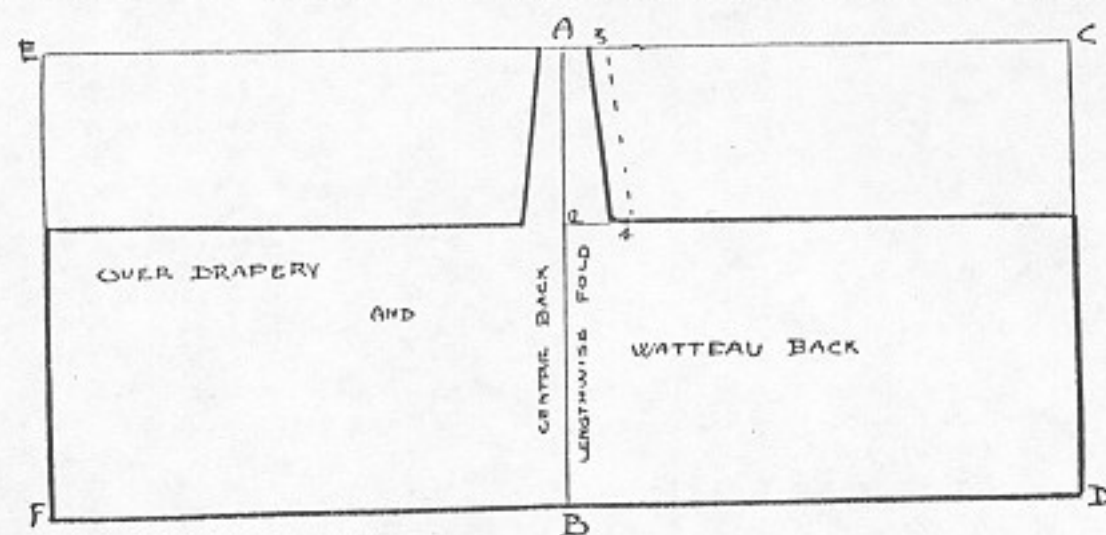


FIG 3

PATTERNS FOR
19 INCH DOLL
SCALE $\frac{1}{8}'' = 1''$



SCALE
 $\frac{1}{8}'' = 1''$

FIG 5

Curve slightly, 2-16 and 1-15, but be careful and not curve too much. Over-drapery and Watteau back. One-half pattern only necessary. Paper 18" X 16". Points: 1 is from C, 6"; 2 from A, 6"; 3 from A, $1\frac{1}{8}''$; 4 from 2, $\frac{1}{8}''$. 3-4, edge of Watteau plait. Dotted line, under portion of plait. To make: Seam waist together at shoulder and under arms. Face lace over fronts of waist and around neck. Gather the top of the sleeve, next baste the seam, try it on to see how closely you have calculated, fit

or cheek. They were cut in the shape of stars, circles, crescents, arrows, and among the very stylish, on state occasions, a whole stagecoach has offered the motif. Of course they were small and dainty, and for the doll should be very small. A fan, rather small in size, is quite a necessary adjunct for a costume for the minuet. Such a fan can be made out of pasteboard and paper, or silk. See a colonial fan if you can. In designing for a child of twelve years old, multiply all these dimensions by three.

it close to the lower part of arm, then French-seam, put ruffle of lace at lower edge, insert sleeve in waist. Vest pattern shows lining portion, to gather lace over, with double lace ruffle as heading at top. In gathering, allow $1\frac{1}{2}$ times amount of lace. Fasten to lining front. Make Watteau plait, fasten to center back of neck under lace collar. Turn under edges of top of shirt, portion 1-4, gather close to edge, and fasten to waist at waist line. Hem fronts, 1-D, and bottom, D-B. Adjust waist and drapery over quilted petticoat which is made straight and full, and tack drapery to petticoat, high on hips at each side of front and back. Petticoat requires one breadth of material for doll's costume, and to the ankles in length. If possible, the typical materials should be used; for the petticoat, quilted satin. For the waist and overdress, the material shown here was blue and white figured silk. The hair should be dressed high in powdered puffs, and black patches (court plaster) should be worn on the face. These were often placed at the corner of an eye, on the forehead, chin

A SWEDISH COSTUME. This offers a problem somewhat new, in that the skirt and bodice are fastened together, so that the weight comes from the shoulders. The skirt is straight and full, but sloped up in front $\frac{1}{2}$ " to meet the high bodice. This allows full skirt portion of the dress to appear above the apron band. Skirt should reach nearly to the ankles. The bodice is laced with cord, allowing the points to draw apart toward the top. A white guimpe is worn under this bodice, and for the front and back you can utilize the waist pattern of the English Peasant Costume. On the front, measure down 4" from A on line A-B, and 1" from point 3 on under-arm seam. Connect these points and cut. On back, measure 1" from 5 on under-arm and 2" from A on A-B. Connect these points and cut. Cap of Sleeve: paper, $5\frac{1}{2}$ " $\times$ $2\frac{1}{2}$ ". Points: 1 is from A, $\frac{1}{2}$ "; 2 from 1, $1\frac{1}{8}$ "; 3 from A, $1\frac{1}{2}$ "; 4 from 3, 1"; 5 from A, $2\frac{1}{2}$ "; 6 from 5, $\frac{1}{4}$ "; 7 from C, $\frac{1}{2}$ "; 8 from 7, $\frac{1}{2}$ "; 9 from C, 1"; 10 from 9, $\frac{1}{2}$ "; 11 from A, $3\frac{1}{2}$ "; E and F are from C and A each 1" respectively. Draw top curve of sleeve through 8-10-11-6-4-2. Lower part of sleeve, Fig. 2: paper, $5\frac{1}{4}$ " $\times$ 7", halved by line E-F. Fold on this line and cut double. Points: 1 from B is $\frac{3}{4}$ "; 2 from D, $\frac{3}{4}$ ", making curve for lower edge of sleeve. Point 3 is from A, 2"; 4 is from C, 2"; 5 and 6, each $\frac{1}{4}$ " from 3, and 4, for inside seam of sleeve. Bodice: paper, $5\frac{1}{4}$ " $\times$ $3\frac{1}{2}$ ". Points: 1 is from A, 2"; 2 is from 1, $\frac{1}{2}$ "; 3, $1\frac{1}{8}$ " from A; 4, $2\frac{1}{4}$ " from 3; 5 from 3 is 1"; 6 from A, $2\frac{3}{4}$ "; 7 from C, 2"; 8 from 7, 1"; 9 from C, 2"; 10 from 6, $2\frac{3}{4}$ "; 11 from 6, $\frac{1}{4}$ "; 12 from 6, $\frac{1}{2}$ "; 13 from 6, $1\frac{3}{4}$ "; 14 from 13, $\frac{3}{4}$ "; 15 from 13, $\frac{3}{4}$ "; 16 from B, $\frac{1}{2}$ ". Armscye curve is through 11-15-10-14-12. Collar: paper, $4\frac{1}{2}$ " $\times$ $2\frac{1}{2}$ ". Points: 1 is from A, 1"; 2 from A, $1\frac{1}{2}$ "; 3 from C, $1\frac{1}{2}$ "; 4 from C, 1"; 5 from 4, $1\frac{1}{8}$ "; 6 from B, 1"; 7 from 6, $\frac{3}{4}$ ". Draw inside neck 3-5-2. Draw outside collar D-7-1. Crown of Cap: paper, 4" $\times$ 3". Point 1 is from C, $\frac{1}{2}$ "; 2 is from 1, $\frac{1}{2}$ "; 3 from B, $\frac{1}{4}$ ". Band of Cap: paper, $2\frac{1}{4}$ " $\times$ $1\frac{3}{4}$ ". Point 1 is from C, $\frac{3}{8}$ "; 2 is from B, $\frac{3}{8}$ ". Side of Cap: paper, $3\frac{1}{2}$ " $\times$ 4". Points: 1 is from A, $\frac{1}{2}$ "; 2 from C, $\frac{7}{8}$ "; 3 from C, $1\frac{1}{8}$ "; 4 from D, $\frac{3}{8}$ "; 5 from C, 2"; 6 from D, $2\frac{1}{8}$ ". 3-4 and 5-6 are edges of plaits. Cut four sections for band of cap and two sections for the collar and crown of cap. Other portions to be cut double only. Seam two



sections of collar together, except on inside curve of neck, then turn and crease. Seam upper part of collar to waist from wrong side, and hem under part into position over seam. Gather straight upper edge of sleeve into lower edge of sleeve cap before seaming inside seam of sleeve. Trim collar and sleeve with bands to match bodice. Hem bottom of guimpe for a draw string. Neck and armscye of bodice are to be faced with bands of same, cut in a true bias. Gather skirt and sew to bodice with placket in front, under apron. The making of the cap must be carefully done; having cut four portions of band, seam each pair around lower edge and plait crown portion of cap into upper edge of band, allowing plaits to extend to top of crown, then seam top edges of crown portions. Set lower edge of crown to upper edge of band, then insert plaited side portions at each side, having the plaits turn towards the back. Seam at each edge, face inside portion

of band and quilt band vertically. The costume as shown in the picture is made of a mercerized muslin, the skirt of a magenta color, and the bodice of yellow. The apron is green, with yellow bands, and cap and guimpe are of white lawn. For a child of ten to twelve years the dimensions must be enlarged three times.

The most brilliant colors of any civilized class of peasantry are those seen in the different parts of the Scandinavian peninsula. The deep valleys of this land have acted as physical barriers between families and villages, until the habits of centuries have become fixed with each, and one result has been the costumes of different pattern and color which now mark certain localities. And what a land of legend, of towering mountain and waving waterfall! The thoughts of ages were woven by a poetic folk into strange and interesting folk tales at an early time. These *sagas*, as they are called in the older Norse tongue, were doubtless well formulated in verse while Britons were yet in the stage of picture writing, and centuries before America was first seen by the earliest sea rovers from the wild Norse coast.

These home songs and stories, poems and records, took note of all phases of life, breathing a water sprite into every cascade and stream, giving to the sea-waves the forms of invisible maidens, and lending a meaning full of poetry to the homeliest acts and habits. In the springtime sang the *Stromkarl*, the spirit of the streams, and girls clad in just such costumes as this one learned with their first conscious memories to sing the old spring song, "Varvindar Friska," in which a wild

but joyous picture is rendered of the spring coming in the northland, when the waterfalls are roaring full, the winds chasing the loosened dead leaves and the cry and song of the spirits of wood and water are everywhere heard. And in just such a costume is supposed to invade the dance that odd creature, the *Hulda*, a spirit-girl from the mountain fields, but with a tail like a cow! She enters at the door when the dance is at its height, says the legend, and is welcomed as a pretty stranger; the sturdiest youth seek her hand in the merry figures, and she, nothing loth, gives cordial consent. When lo, suddenly someone discovers the tail; there is a scream, the dance wavers, and the *Hulda* vanishes! Such is one legend of the winter fireside.

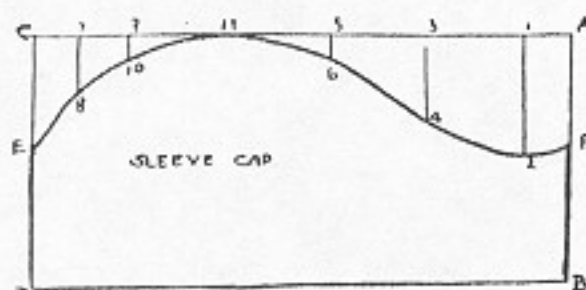


FIG. 1

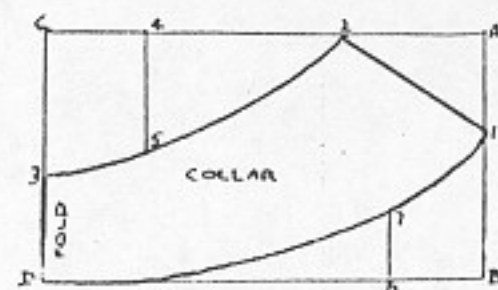


FIG. 4

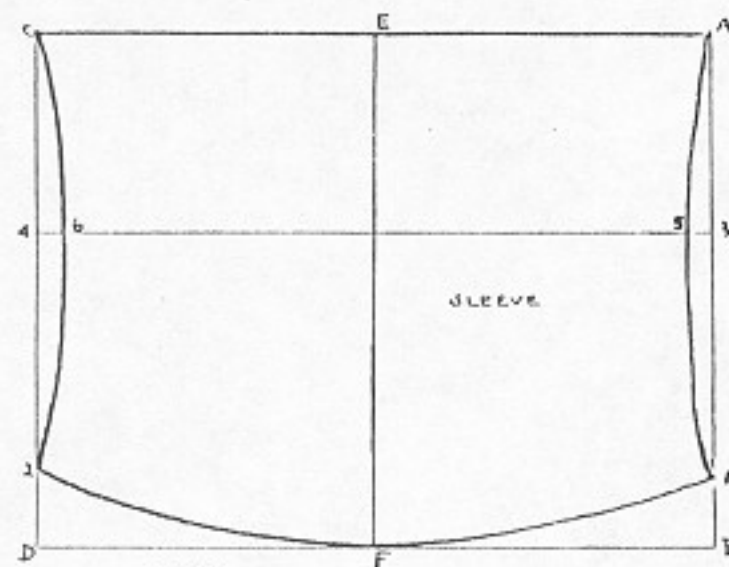


FIG. 2

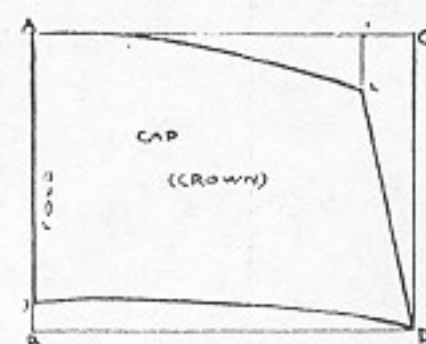


FIG. 3

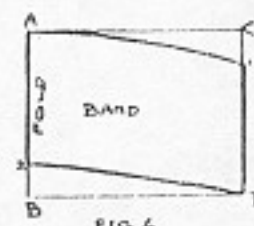


FIG. 6

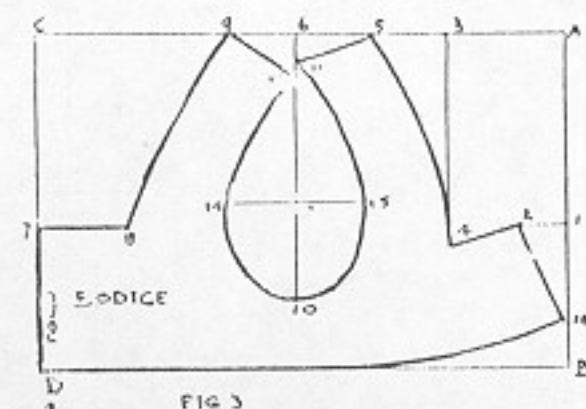


FIG. 5

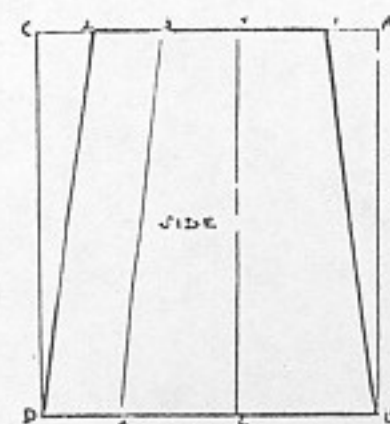


FIG. 7

PATTERNS FOR 19" DOLL
SCALE $\frac{1}{4}$ " = 1"

SCOTTISH HIGHLAND COSTUME. Jacket: paper, 8" $\times$ 9". Points: 1 is from A, $\frac{1}{2}$ "; 2 from A, 1". 1-2 is back of neck. 3 is from A, 2". 2-3 is front of neck. Four is from C, 2"; 5 straight in from 4, 5". Draw 5-D. Place 6 on this line $\frac{1}{2}$ " from 5. 7 is from B, $2\frac{1}{2}$ "; 8 from B, 5"; 9 from 8, 1". 4-6-9 is sleeve seam and under-arm seam; 7-9 is rounded bottom of jacket. For Cuff: paper is $4\frac{3}{4}$ " $\times$ $2\frac{1}{2}$ ". Points: 1 is one-half of line A-B; 2 is from A, $\frac{1}{2}$ "; 3 is from B, $\frac{1}{4}$ "; 4 is one-half of C-D. Curve as shown. The Sporran, a leather purse-pocket to hang from belt. Paper: $4\frac{1}{2}$ " $\times$ $1\frac{3}{4}$ ". Points: 1 is from A, $2\frac{3}{4}$ "; 2 from C, $2\frac{3}{4}$ "; 3 from A, $\frac{3}{4}$ "; 4 from C, $\frac{3}{4}$ "; 5, one-half from A to 3; 6, one-half from C to 4. Fold on 3-4 and 1-2. Cap:

paper, 8" square. Fold in quarters. For point 1, measure distance A-B from B on line C-D, and draw circle freehand. Draw another inside this, radius $2\frac{1}{2}$ " through 2-3-4. To cut and make. The Jacket: open pattern at fold and place on double thickness of cloth, with lines A-B at selvage edges. Seam back of jacket, curving slightly in at waistline, and leaving center back seam open $1\frac{1}{2}$ " at bottom. Join sleeve and under-arm seams, leaving latter open $1\frac{1}{2}$ " at bottom of jacket. This allows for the wide scallop effect always seen on the dress jacket of a Highland gentleman of the old days. Face all edges with narrow facing cut on true bias. Neck may be finished with band cut lengthwise straight of material, and a stand-up collar worn inside. Fronts of jacket to laps with buttons. Cuffs: cut with long, straight edge lengthwise of material. Face curved edges with bias piece of material. Seam cuffs on to sleeves, from the wrong side, turning on to right side, and finish points with buttons. The Sporran, Fig. 3, in doll's size, may be fashioned from an old kid glove if no other leather or skin is at hand. The pocket is made by folding up on line 1-2 and stitching edges and the flap by folding 3-4 over the open top of this pocket. A fringe may be stitched on to the bottom. The straps by which the sporran is hung to the waist-belt should be very small, and have loops at the top, flattened, for the belt to slip through.

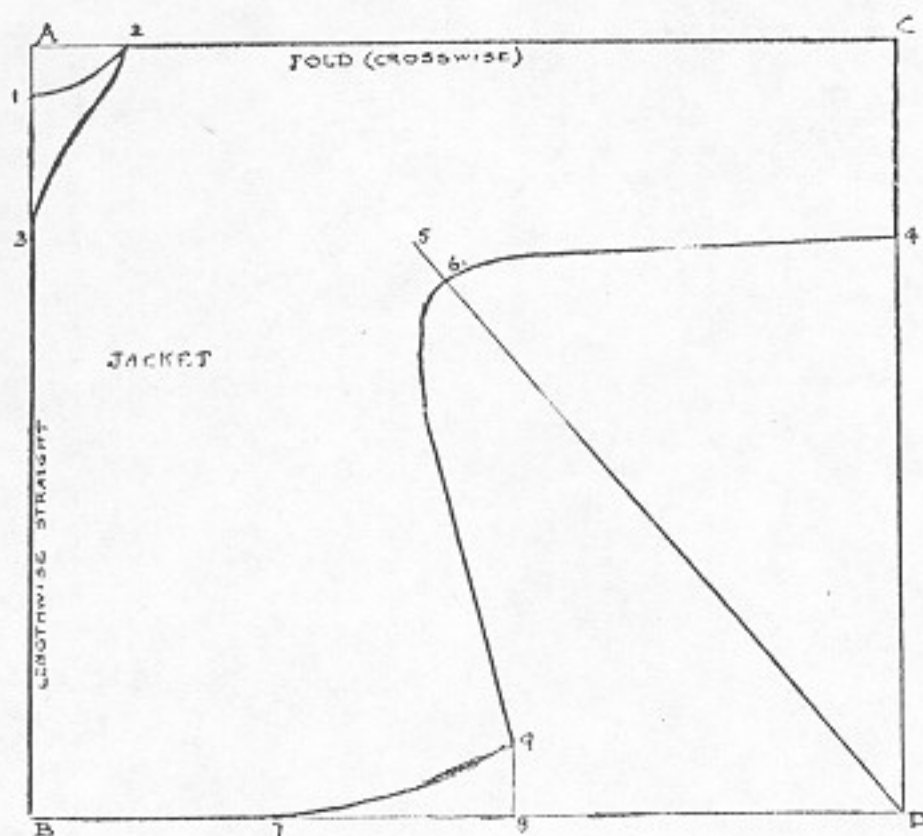


FIG 1

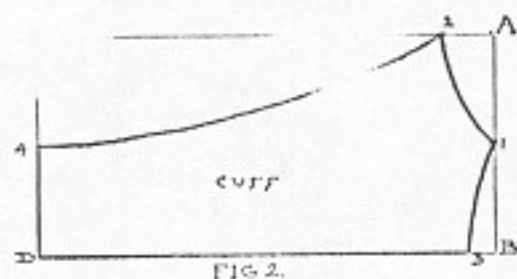
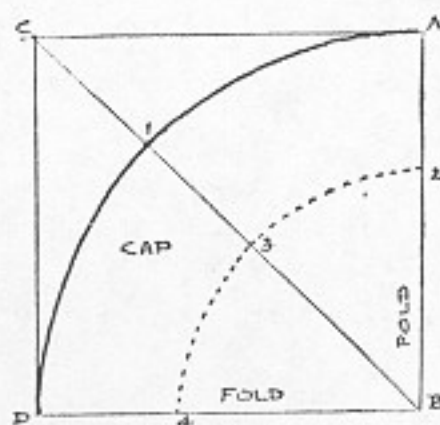


FIG 3



PATTERNS FOR 19" DOLL
SCALE $\frac{1}{2}$ " = 1"

The cap is cut from cloth with lines A-B or B-D, lengthwise. Turn over on inner circle and lay fullness in plaits, sloping these directly towards center. Sew into a straight band just the head size. Finish cap, at left side, with quill and rosette. The plaided portion of the suit is in this case modeled after the more ancient garment, where the kilt or philabeg, and the shoulder blanket, now known as the plaid, were all in one piece. The wearer wrapped this long strip around his body at



pin. Some of the actual shoulder brooches worn were very large, often as much as four inches across, and richly jeweled. Allow the free end to hang down in front. The tartan will cross at the opening of the seam in right side of jacket, if rightly placed. Hang another belt over right shoulder, and under left armpit, for the sword-sheath. The costume shown here is made from red plaid goods, with a jacket of a quiet, harmonizing tone. The stockings are cut from the plaid cloth, on a true bias. The cap is made from blue cloth and the rosette from blue binding ribbons to match. For a child of ten to twelve years, multiply these dimensions by three. This costume is one of the most striking and warlike among the peoples reckoned as civilized. Indeed, in the days of their earlier existence the people of the Highlands could hardly be said to come under the class of any considerable degree of civilization. The tribal conditions prevailed, and the chief of the clan was supreme ruler and law unto the clan. There is about the costume a dash and swing that no other possesses.

"O, our sojer lads looked braw, looked braw —
Wi' their tartan, kilts, an' a', an' a';
Wi' their bonnet an' feather an' glitterin' gear,
An' the pibroch sounding loud an' clear!"

the waist after carefully plaiting it into folds to suit his own fancy, and then buckled his belt around him to hold it in position. The long free end was then carried up the back and over the left shoulder, where it was fastened by the brooch, on the front side. Sometimes, if it was extra long, it was wound about the body before fastening, over the left shoulder and under the right armpit. This ancient garment is made in the doll's size by taking a strip of plaid 54" long and 8" wide, and laying plaits according to the pattern of the plaid, the number depending on the waist size. Beginning at right side, place around body of doll. Where it meets around the body, fasten with a stitch or use a doll's belt. Then carry the remaining free end, plaited the opposite way of the material, up the back and over the left shoulder to the front, passing it through a buckle or fastening with a breast-

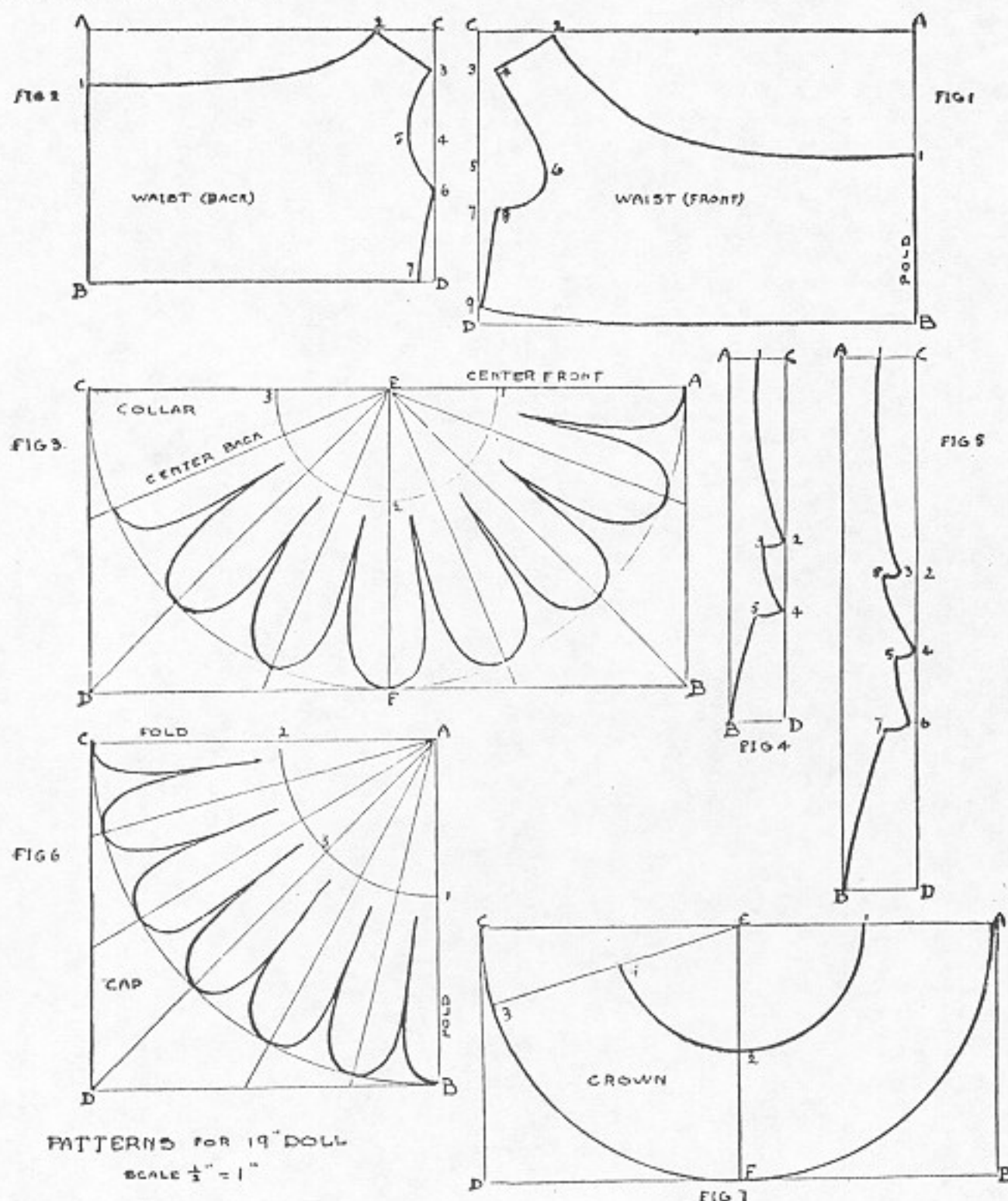
The kilt of to-day is reduced to a sort of skirt, kilted after a fashion known to the military tailors of England, and is held in place by a short strap and buckle, while the military plaid is merely a light-weight length of cloth, caught by the brooch. The skin of the sporran has the hair on, a silver top or crest, and three tassels of a hair darker than the sporran. In full dress the ancient dirk knife dangles at the right side of the sporran, and stuck in its sheath are the soldier's knife, fork and spoon. You will remember the amusing case of the redoubtable Rob Roy, told in the book of that name by the great Sir Walter Scott; of how the chief had made an elaborate lock to the pocket of his sporran, which would discharge a loaded pistol at a thief. It did not seem to occur to him that one might cut the skin and not disturb the lock. Perhaps some traveler friend can buy for you one of the exquisite little toy "stands" of pipes to match the suit.

A DAISY COSTUME, SUITABLE FOR MAY-TIME. This costume represents one of the spring flowers, the daisy, which, with other flower-dresses, is suitable for a dolls' May party, or if made up in full wearing size, may deck some little maid most prettily for the Maypole dance and the other festivities of that happy time. For the doll size the paper pattern should be, for Waist Front, $6'' \times 4''$. Place and letter as in chart. The points are: 1 is from A, $1\frac{3}{4}''$; 2 is from A, $5''$. Draw freehand curve for neck, making a full, deep curve, as it is for front of neck. Point 3 is from C, $\frac{1}{2}''$; 4 is from 3, $\frac{1}{4}''$; 5 is from C, $2''$; 6 is from 5, $1''$; 7 is from C, $2\frac{1}{2}''$; 8 is from 7, $\frac{1}{4}''$. Draw curve for armseye, 4-6-8. Point 9 is from D, $\frac{1}{4}''$. Draw under-arm seam 8-9. Back of Waist, Fig. 2. Paper: $4\frac{3}{4}'' \times 3\frac{1}{2}''$. Point 1 is from A, $\frac{3}{4}''$; point 2 from A, $4''$. Draw freehand curve for neck, more shallow than for front. Point 3 is from C, $\frac{1}{2}''$; 4 is from C, $1\frac{1}{2}''$; 5 is from 4, $\frac{3}{8}''$; 6 is from C, $2\frac{1}{4}''$; 7 is from D, $\frac{1}{4}''$. The Collar, Fig. 3. Paper: $4'' \times 8''$. Divide in center by line E-F. With center at E and radius E-A, draw circle for construction. With same center draw another circle with radius E-1, which is $1\frac{1}{2}''$. Divide circle as shown and draw petals freehand. The Leaf, Fig. 4. Paper: $\frac{3}{4}'' \times 5''$. Point 1 is one-half of top line A-C. Point 2 is $2\frac{1}{2}''$ from C; 3 is $\frac{1}{4}''$ from 2; 4 is $3\frac{1}{2}''$ from C; 5 is $\frac{3}{8}''$ from 4. The Large Leaf, Fig. 5. Paper: $7\frac{1}{4}'' \times 1''$. Point 1 is one-half of top line A-C. Point 2 is from C, $3''$; 3 is from 2, $\frac{1}{4}''$; 4 is from C, $4''$; 5 is from 4, $\frac{1}{4}''$; 6 is from C, $5''$; 7 is from 6, $\frac{1}{2}''$; 8 is from 3, $\frac{1}{4}''$. The Cap, Fig. 6. Paper is $4\frac{3}{4}''$ square when folded four double. With A as center draw two circles, one radius A-B, the other radius of $2''$, or A-1. Divide circle as in chart and draw petals freehand. The Crown, Fig. 7. Paper: $7'' \times 3\frac{1}{4}''$. Divide by line E-F. With E as center draw circles with radius E-F, and E-1, which is $1\frac{3}{4}''$. In making this costume, cut all material with lines A-B or E-F of patterns lengthwise straight of goods, cutting A-B of front of waist on a lengthwise fold. Allow for hems on back of waist. Gather waist to fit neck of doll, and face neck with bias facing. Cut out neck of collar at inner circle. Place piping of yellow at inside of neck. Face armseye with bias facing. Cut four large and

six small leaves for each armseye, sewing them on from the wrong side, two large leaves at under-arm seam, and two at shoulder, and three small leaves at each side of armseye, so that they will fall over the arm instead of sleeves. Gather bottom of waist into band of required size for waist, and also gather straight full skirt into same band, making skirt ankle length. Draw the cap pattern on pure white paper and paste pattern on to white lawn before cutting out petals. After cutting petals curl them over pencil. Cut head size at inner



circle. Paste crown of cap on to green material before cutting. Fasten edges $1''$ and $\frac{3}{4}''$ of crown together, then fasten petal portion to crown. Cut six small leaves for crown and fasten to center opening so that they will fall over calyx portion. For a full-size costume,



of ten to twelve years, multiply these dimensions by three. Barring Christmas, there is probably no time of the year which has been so much written about as May, the gem of the springtime. The first of the month commemorates the breaking forth into beauty of all nature, after the stern hand of winter has held all in its grasp for months. The Romans celebrated this season with their Floral Games, the festivities beginning on April 28 and lasting for several days, and from this time the celebration of the season has continued, though at some periods of history a greater or less decadence has set in. To see the observance of May Day at its fullest, we have to study the village customs of old England in the 16th century. The day was celebrated with all manner of sports, music and dancing, and it was customary for the middle classes to go forth

carried out in the queen selected for the floral fêtes held in the west and south, in our own country. Villages tried to outdo each other in the size and decorations of their Maypoles, and of a number erected in London, one had a most curious and interesting history. An old letter, descriptive of May Day, 1610, is as follows: "Last night I slepte but ill soe was awake in the dawne of day, and forth to coole my braine in the freshe dewinesse of the earlie morne. There was a tumult of sweete sounde from the throat of a thousand birdes till alle the ayre from far and neare, was fulle of theire jubilate and all the breath of the morne was laden with the bitter fragrance of Maye. (The hawthorn.) They have decked the village alle out, lintel and beame." During Cromwell's time Parliament ordered all Maypoles removed and enforced this ruling by severe penalties.

early in the morning to gather flowers and hawthorn branches for garlands to decorate the doors and windows of all the houses. This was called "bringing home the May" and is referred to by Chaucer in his "Court of Love." "Forth goeth all the court, both most and least, to fetch the flowers fresh." It was also the custom to erect, in every village and town, a high pole, called the Maypole, and on the first day of May this pole was decorated, and the young men and maidens danced about it during the day and evening. A May Queen was chosen to whom all paid homage during the festivities, this no doubt being a custom handed down from the Romans, who performed rites to the goddess Flora, during their spring celebration. We still have this idea

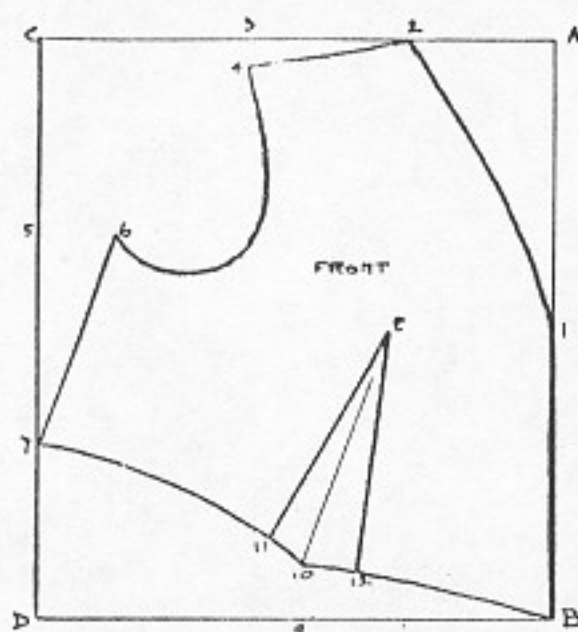
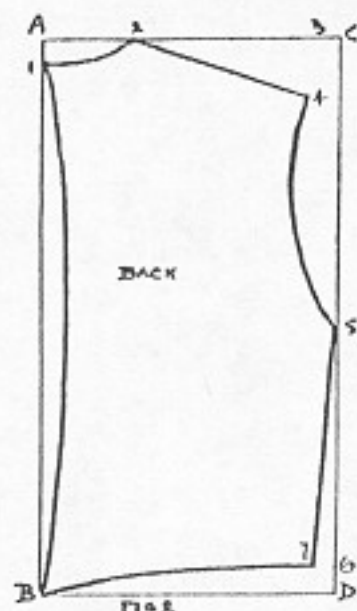
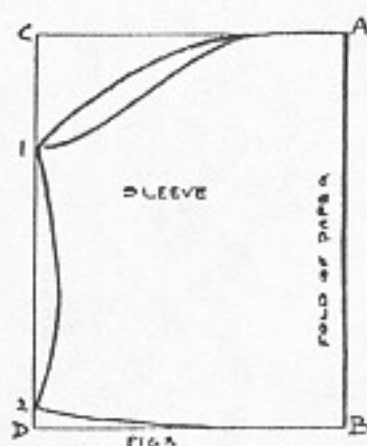


FIG. 1.



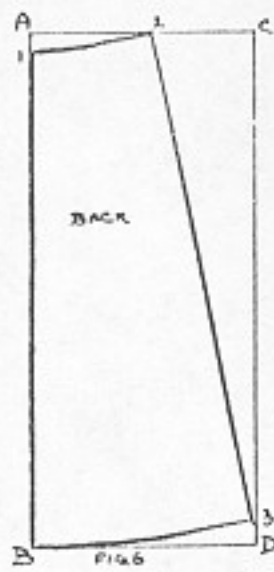
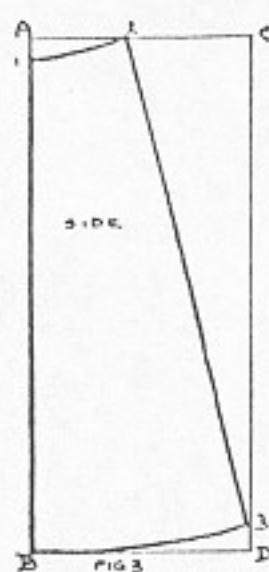
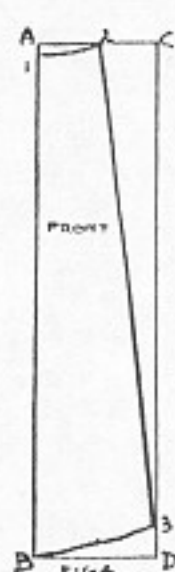
PATTERNS
FOR
19" DOLL

SCALE FOR WAIST
 $\frac{1}{2}'' = 1''$

SKIRT FOUNDATION

SCALE $\frac{1}{4}'' = 1''$

$1\frac{1}{4}''$; 2 from D, $\frac{1}{4}''$. The sleeve is gathered top and bottom, and trimmed with bands of contrasting color. Seam lines 8-11 and 8-12 of waist front together. Curve in back center of waist to fit. Join 1-B of side gore of skirt to 2-3 of front gore, and 1-B of back gore to 2-3 of side gore. Leave placket. Outside skirt to consist of 3 straight flounces overlapping, allowing once and a half for fullness. Mantilla is made of lace or thin silk, three cornered in shape, adjusted over a comb at the back, with the point of lace at the forehead. Part hair in middle and place a bright flower over each ear. This costume was made of white dotted muslin trimmed with black velvet ribbon. Cut all parts of patterns with lines A-B straight lengthwise of material, opening sleeve and placing fold A-B straight lengthwise. Place A-B of back of waist and A-B of front gore of skirt on lengthwise folds.



SPANISH COSTUME. Front of Waist. Paper: $6'' \times 5\frac{1}{4}''$. Points: 1 is from A, $3''$; 2 from A, $1\frac{1}{2}''$; 3 from A, $3\frac{1}{8}''$; 4 from 3, $\frac{1}{4}''$; 5 from C, $2''$; 6 from 5, $\frac{3}{4}''$; 7 from C, $4\frac{1}{4}''$; 8 from 1, $1\frac{3}{4}''$; 9 from D, $2\frac{3}{4}''$; 10 from 9, $\frac{1}{2}''$; 11 and 12 each $\frac{1}{4}''$ from 10. 1-2 is neck front; 2-4, shoulder line; 4-6, deep curve for front movement of arm in armseye; 6-7, under arm. Back of Waist. Paper: $5\frac{3}{4}'' \times 3''$. Points: 1 is from A, $\frac{1}{4}''$; 2 from A, $1''$; 3 from A, $2\frac{3}{4}''$; 4 from 3, $\frac{3}{4}''$; 5 from C, $3''$; 6 from D, $\frac{1}{4}''$; 7 from 6, $\frac{1}{4}''$. Puff Sleeve. Paper: $8'' \times 3\frac{1}{4}''$. Point 1 is from C,

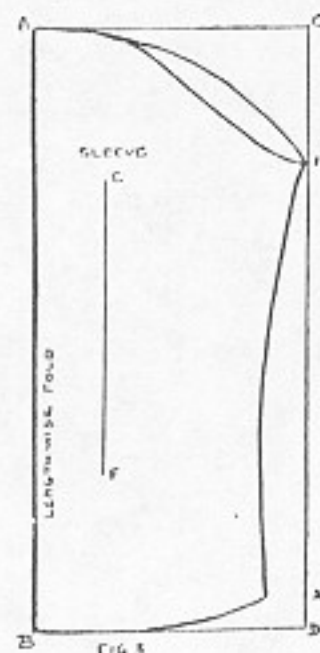
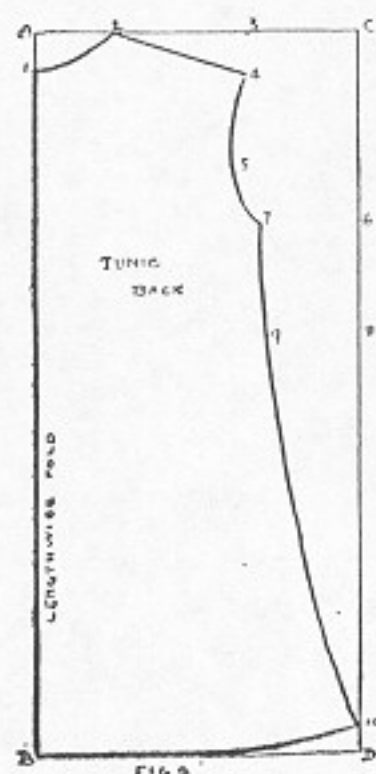
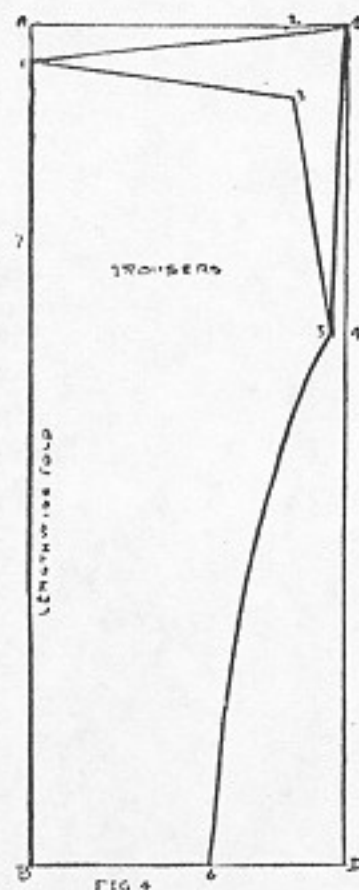
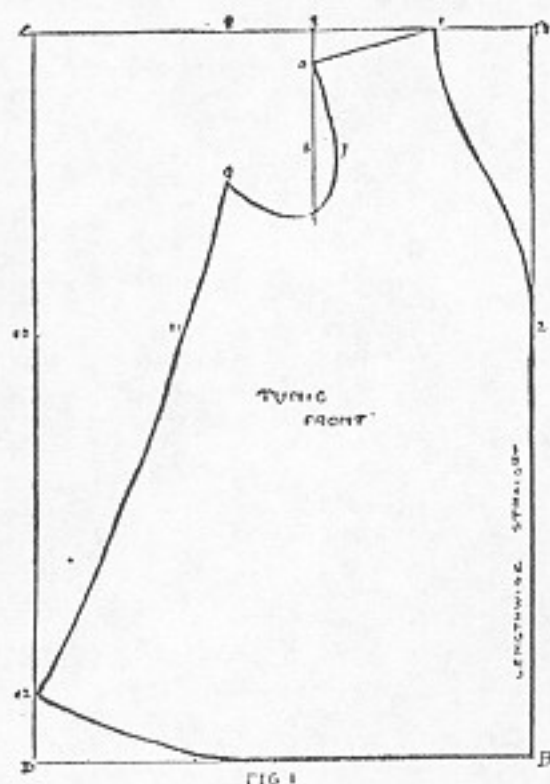




COSTUME OF A BARD OF ANCIENT IRELAND. One of the most interesting doll costumes of this series. It deals with a people older than those of the Scottish Highlands, and in fact the parent stock which gave them being, a people whose civilization — perfected to a degree, and undoubtedly polished in its life of castle and court — antedates that of the Highlands by centuries. The efforts of Irish scholars and historians to follow the ancient lineage back to the coasts of the Continent, and through the Mediterranean to the birth-place of our race, are well worth following by the student. They lead back to the tenth chapter of Genesis and are concerned with Gomer, Javan and Dodanim, of the line of Japheth. Music was early brought to a degree of great perfection with the Irish, and the harp, doubtless handed across the ocean from the days of the Shepherd King David, seems to

have been their chief mode of expression in melody. The Bards, however, were not the musicians of their day; they were rather the poets, whose songs were usually sung by the minstrels who accompanied them. Nor were they like the musical rabble which overran the Continent in the later Middle Ages, whose members, mere wandering players, had in a sense to beg their living. These Irish Bards were men of high degree, and were educated, under the tutelage of the monks, in the history and craft of their native land. They became a sort of guild, which at one period grew to such numbers that their maintenance became a public burden. From the time of the conquest of Ireland by Henry II the profession began to decline, though long cherished by the lovers of music, and still a precious memory in the minds of every true Irishman. The harp, according to the beautiful folk tale that Thomas Moore has preserved in verse, was once a sea-maiden, whose grief for the lover who came no more wore her away to death, a story which is brought to mind by the form of the post of the harp as it to-day appears on the flag of Ireland.

In the Gaelic speech the larger harp was called *Clairseach*, and figured at state banquets and royal occasions. It had from twenty-nine to fifty-eight strings, showing that the harmonization of ten centuries or more ago could have been of no mean order. The harp is referred to in the literature of the ninth century and appears in sculpture of the tenth century. A bit of Irish tradition thus brings in the harp: "A small but singularly sweet and very beautiful Harp, which had belonged to *Donnechadh Cairbreach O'Brien*, whose father was one of the last of the Irish kings, had by some means been removed to Scotland, and *MacConnedke*, the poet to this Irish chief, was directed by his master to endeavor to recover it, either as a free gift, or in exchange for a flock of fine Irish sheep. The envoy failed to induce the Scottish chief to restore *O'Brien's* harp, and on his return wrote a beautiful poem which details the effort and failure to regain the instrument. It is written in the peculiar spirit of the ancient Irish verse and one cannot read it without feeling the reality of the story. Once a year the Bards met in convention at



PATTERNS

FOR

19" DOLL

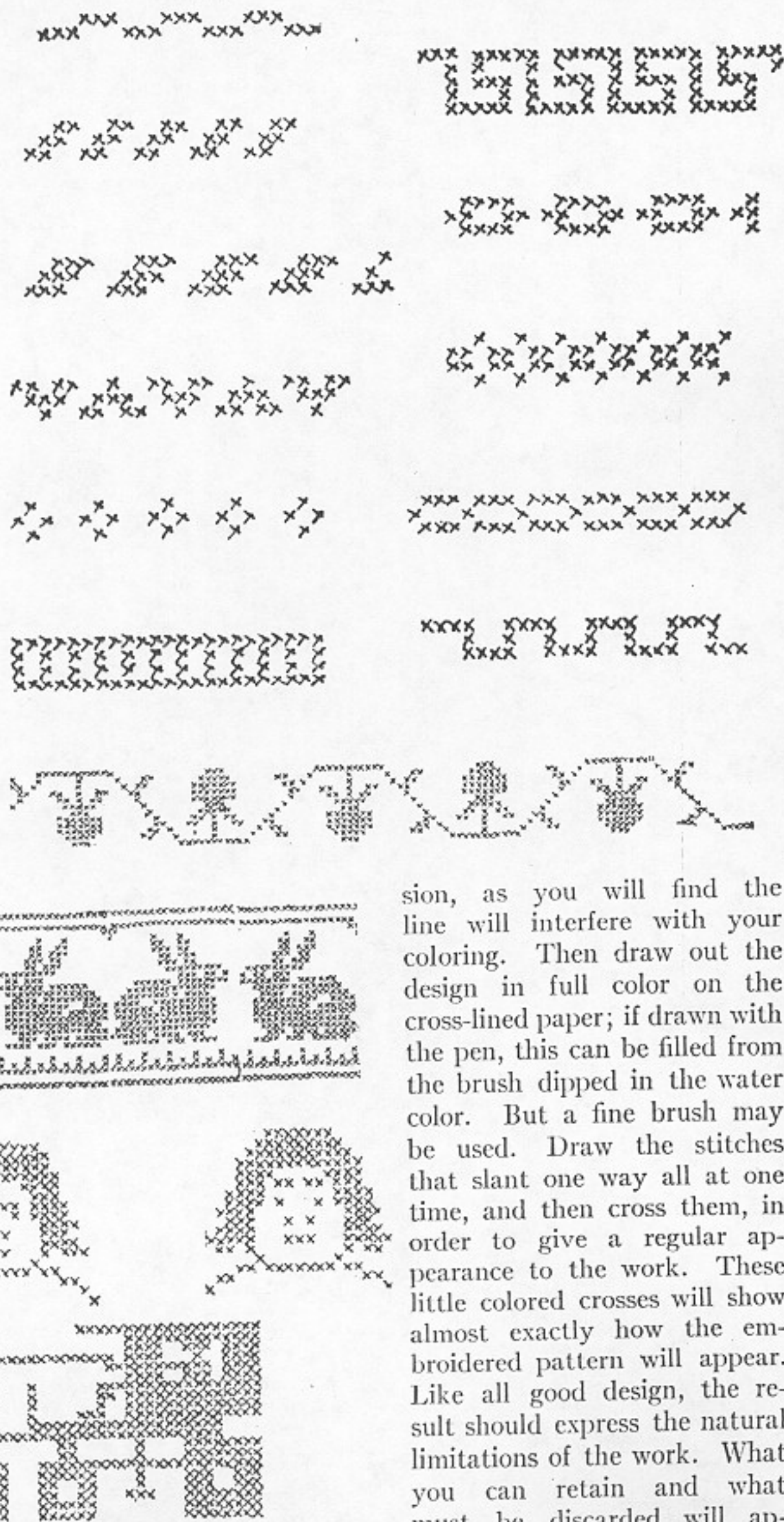
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Tara, the ancient seat of Irish government, where contests of their skill were held, and which were attended by the great of the land." Directions for the Costume. Paper for the Tunic: $9\frac{1}{2}" \times 6\frac{1}{2}"$. Points: 1 is from A, $1\frac{1}{4}"$; 2 is from A, $4"$; 1-2, neck curve. 3 is from A, $1\frac{3}{4}"$; 4 from 3, $\frac{1}{2}"$; 5 from 3, $2\frac{1}{2}"$; 6 from 3, $1\frac{1}{2}"$; 7 from 6, $\frac{1}{2}"$; 8 from A, $4"$; 9 from 8, $2"$. 4-7-5-9, armseye. Point 10 is from C, $4"$; 11 from 10, $2"$; 12 from D, $1"$. Back of Tunic, Fig. 2. Paper: $4\frac{1}{4}" \times 9\frac{1}{2}"$. Points: 1 is from A, $\frac{1}{2}"$; 2 from A, $1"$; 3 from A, $2\frac{3}{4}"$; 4 from 3, $\frac{1}{2}"$; 5 from 3, $1\frac{3}{4}"$; 6 from C, $2\frac{1}{2}"$; 7 from 6, $1\frac{1}{4}"$; 4-5-7, armseye; 8 is from C, $4"$; 9 from 8, $1\frac{1}{4}"$; 10 from D, $\frac{1}{2}"$. The Sleeve, Fig. 3. Paper: $7" \times 8"$. Note fold. Points: 1 is from C, $1\frac{1}{4}"$; 2 from D, $\frac{1}{2}"$; 3 from 2, $\frac{1}{2}"$. Cut through both thicknesses of paper

from A-1 on outside curve, then curve in one side slightly for under part of sleeve. Open flat, slash at E-F, $1"$ in front of fold, to show shirt sleeve. Trousers, Fig. 4. Long and tight, and in full size must be fitted. Paper: $11" \times 8"$. Points: 1 from A, $1\frac{1}{2}"$; 2 from C, $\frac{3}{4}"$; 3 from 2, $1"$ (the center of the front at the waist); C is center at the back. 4 is from C, $4"$; 5 is from 4, $\frac{1}{4}"$; 6 from B, $2\frac{1}{2}"$; 7 from A, $3"$; 1 to B is outside of leg. Shoe, Fig. 5. Paper, $2\frac{1}{2}" \times 4\frac{1}{2}"$. Points: 1 is $1\frac{1}{2}"$ from A; 2 is from A, $2"$; 3 is from A, $2\frac{1}{2}"$; 4 is from 3, $\frac{3}{4}"$; 5 is from B, $1\frac{1}{4}"$; 6 is from C, $2\frac{1}{2}"$; 7 from 6 is $\frac{1}{2}"$. Curve 1-2 is pointed toe and 1-D is ankle. Point 1 is between A and C. To cut:

Place Fig. 1 with line 2-B on selvage edge. Place Fig. 2, line 1-B, on lengthwise fold. Fig. 3, open out pattern and place with line A-B straight lengthwise. Fig. 4, do the same with 1-B lengthwise. Fig. 5, place 2-B on lengthwise fold. To make: Trim tunic around edges, also edges of slash in sleeves with fold of contrasting color. Finish lower edges of sleeves by gathering into wrist, leaving frill at hand. Seam leg parts of trousers before putting the two parts together, then seam two front edges 3-5 together, then back edges, C-4. Open at each side, 1-7 for placket, and finish with facing. Seam Shoe, 1-2, and 1-7 also 5-D. Seam curved edge 4-5 into curve of sole. The shirt is only seen at neck and sleeves, and the shirt-waist for the German Costume will answer for this. For the collar, that of the Swedish Costume will be correct. The hat is essentially the same as that for the Scottish Highlander Costume, substituting a soft plume for the quill. In selecting color do not hesitate to use bright hues, a vermilion being proper for one.

CROSS-STITCH EMBROIDERY is among the very ancient of the needle arts. The samplers of our grandmothers were collections of the designs selected and treasured by them, to be wrought into this style of work. In making, try to reduce the forms used to their simplest shape, and discard all small details of outline. Two complementary colors, one of course predominating, are best for beginners in this work, and practice in the stitches shown at the right is desirable. When the space has been selected to embroider, such as a collar and cuffs, the design should be worked out on plain paper, and when satisfactory redrawn on cross-ruled paper, where the cross-stitches must be drawn as they will appear, each square when filled representing a square of the embroidered design. The experimental drawing may be transferred to the cross-lined

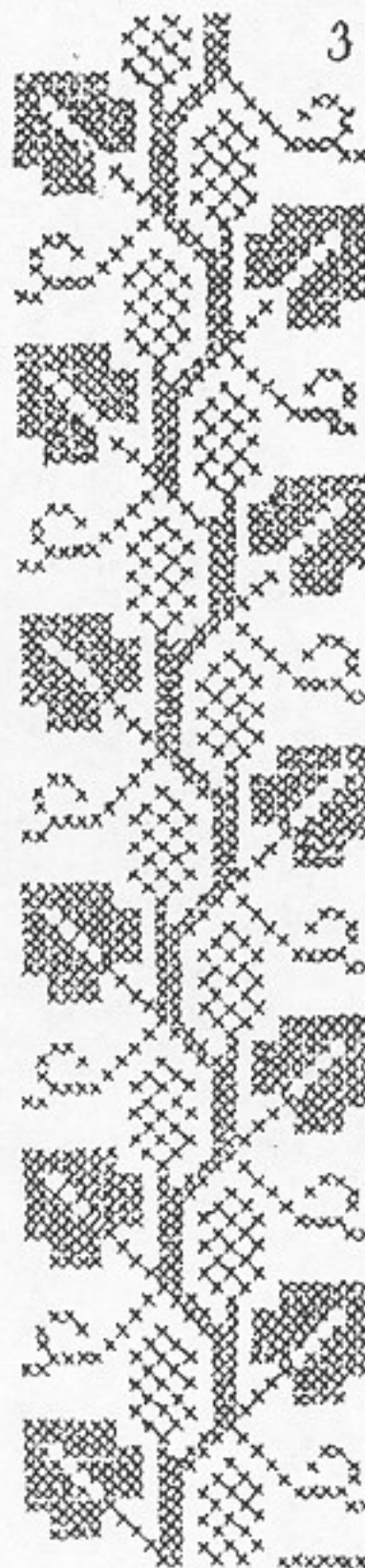


sion, as you will find the line will interfere with your coloring. Then draw out the design in full color on the cross-lined paper; if drawn with the pen, this can be filled from the brush dipped in the water color. But a fine brush may be used. Draw the stitches that slant one way all at one time, and then cross them, in order to give a regular appearance to the work. These little colored crosses will show almost exactly how the embroidered pattern will appear. Like all good design, the result should express the natural limitations of the work. What you can retain and what must be discarded will ap-

pear in preparing the design for its final stage. paper by tracing- and impression-paper, but be sure to make the lightest possible impres-

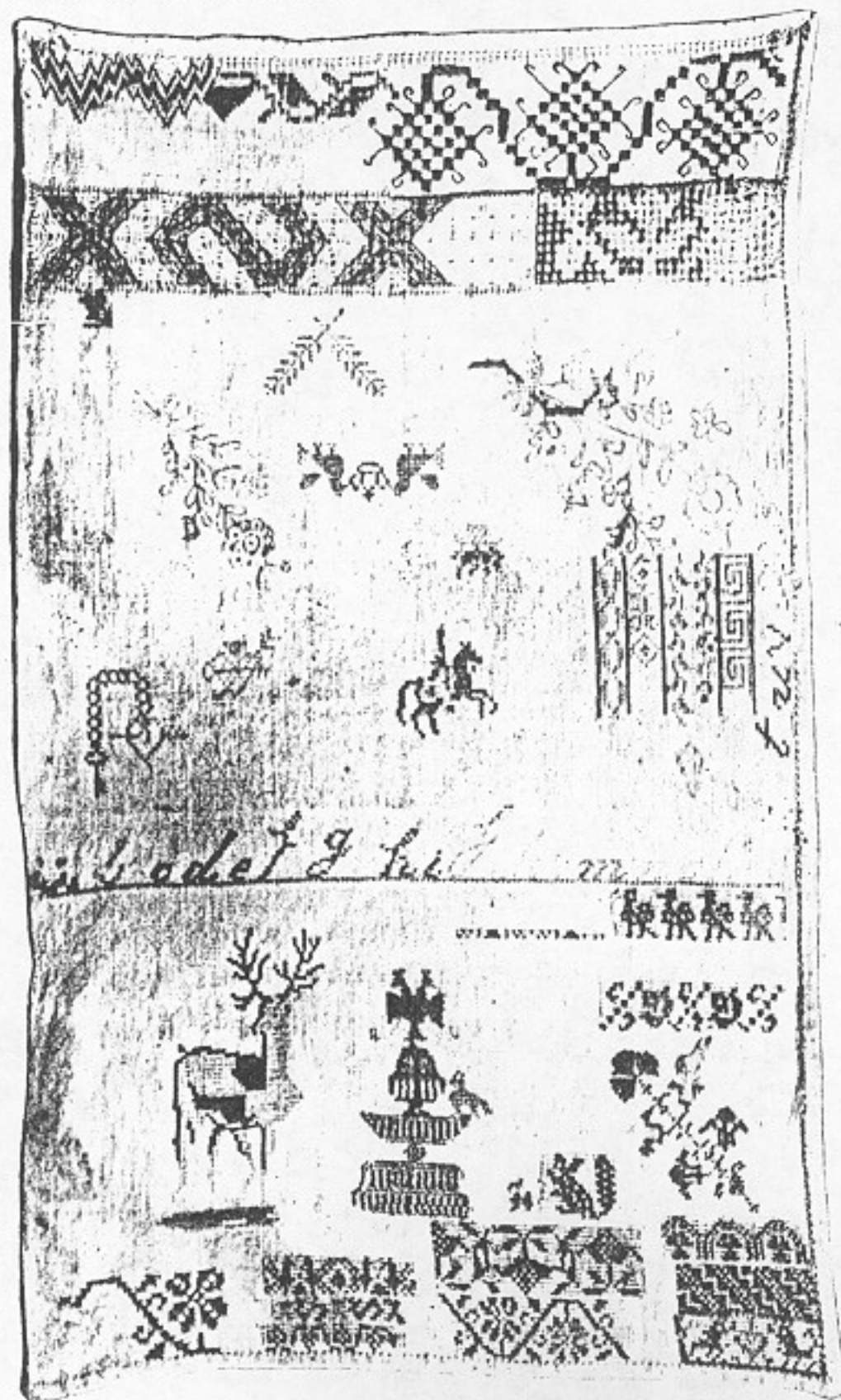
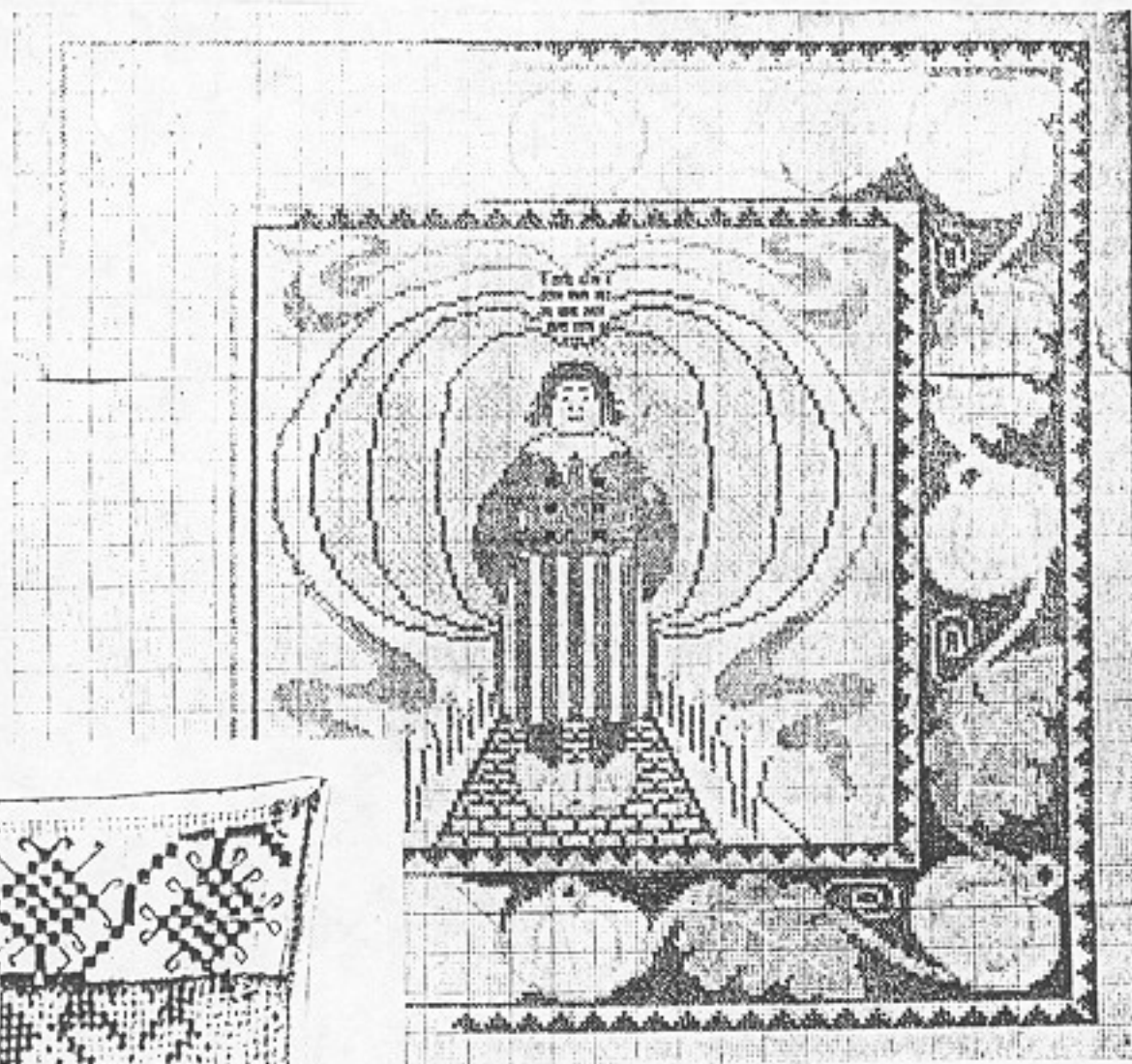
CROSS-STITCH EMBROIDERY. Some designs for vertical bands and an ornamental initial. Such borders, especially if somewhat simplified, might be embroidered upon scrim curtains. As for the initial, it is a unit which demands space in so many locations that it would be hard to enumerate them. Such bands or borders should of course, if possible, be derived from floral units, as these have a more flowing spirit, in which the movement is greater, and the sense of progression or growth more pronounced. Fig. 8, for example, is based upon the rose. The lilac, with its great number of small but very simple blossoms, each adapted to the filling of a square, as contrasted with its good-sized leaves, offers a unit for this work. But there is no end to the possible adaptation of flower forms, and in well-selected color schemes that shall embody the natural colors of the flowers with analogous or complementary border lines, if such are suitable for the unit. Consider the oak with its leaf and acorn — that wonderfully adaptable nut-form — or the seeds of the ash or maple; all

these offer delightful vistas of beauty to be realized in colored silks. The revival, at the present day, of many of the arts and crafts of earlier days, has attracted attention to this art that was so much in vogue in the days of our grandfathers, and there is no reason why it should not be adapted to modern requirements. It will give to schoolgirls a chance to add a touch of individuality to their apparel and other belongings that will always be interesting to themselves and to others, and may open the way to a wider field. Its ancient lineage should also recommend it to those who love the genuine, the things that endure in spite of all changes. Specimens have come down to us of early Egyptian, Coptic and Byzantine embroidery of this

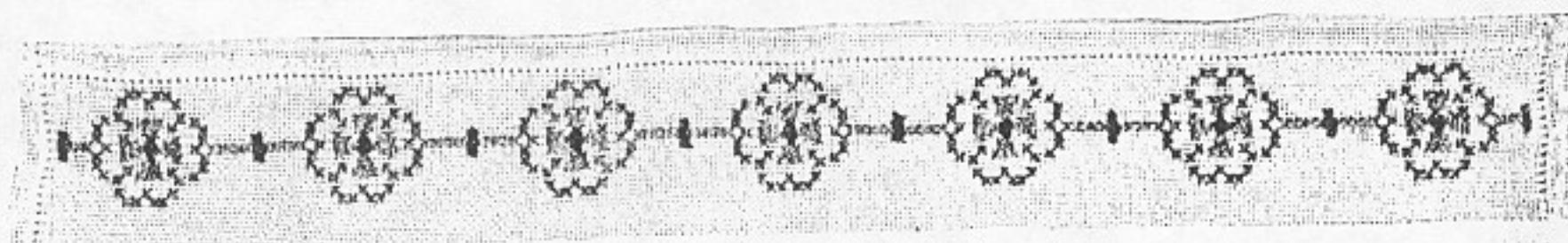
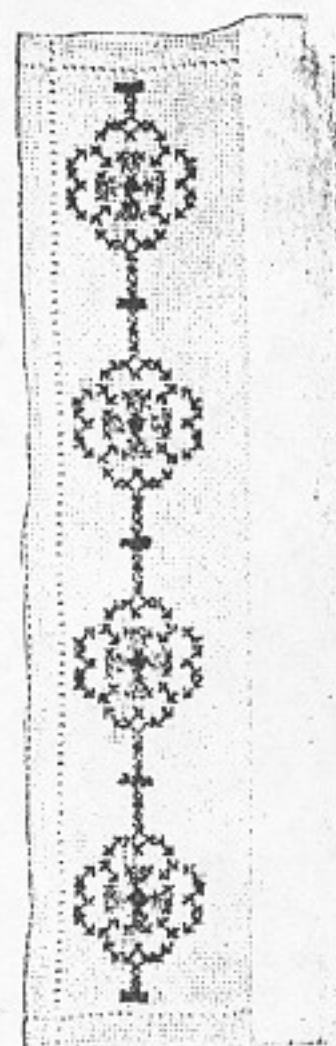
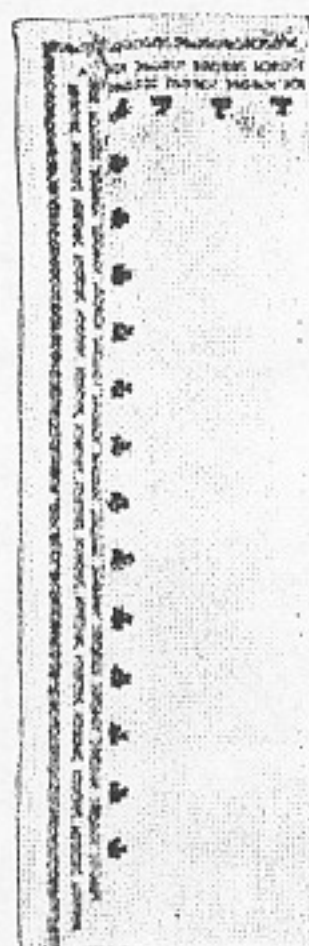
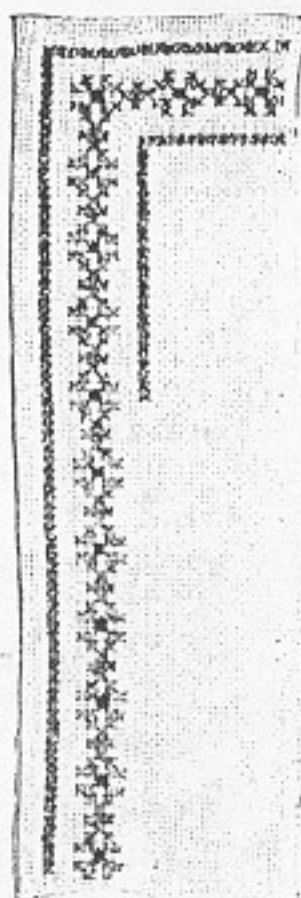
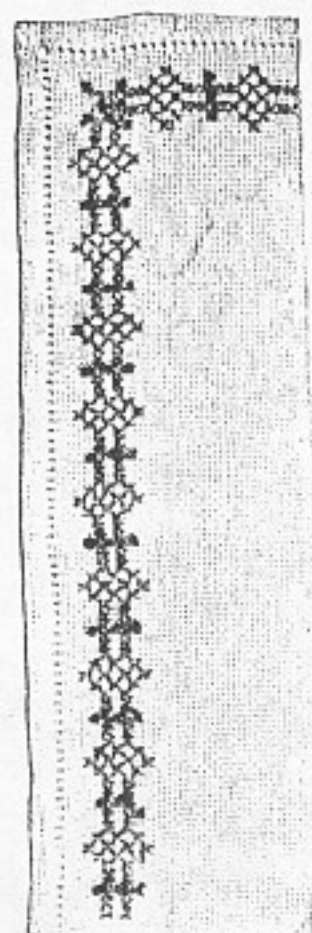


sort, that are sure to make the thoughtful person stop and ask if those civilizations were, after all, so very remote and rude. One priceless fact this style of embroidery teaches to the student; for whereas in many lines of design it is often hard to hold oneself to conventional treatment, in cross-stitch it is hard to do any but conventional rendering. Note the success of the wheels in the carryall design on the page preceding. Square, conventionalized, yet wheels, clearly enough. The up-flirted tail is also well expressed. It is much easier to work on material that has a canvas weave where four threads form a square, but linen of the ordinary weave can be used in the same way, counting four threads usually to a square.

CROSS-STITCH EMBROIDERY; some applied designs. The upper design is the cushion for a chair-back for a child's room. Three trials of the face appear on page 158. The method pursued was as follows: Several small rough sketches were first made, embodying different ideas and subjects, and from these the most satisfactory one was selected. The size of the cushion was next decided upon and a suitable width set off for a border; an experimental drawing was made of the border and center

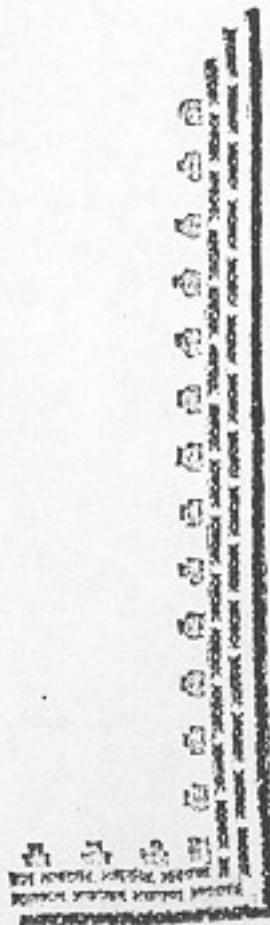
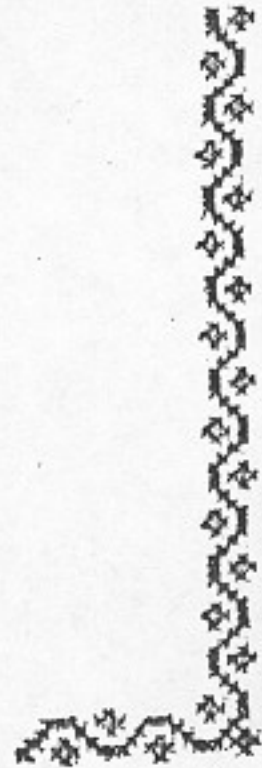
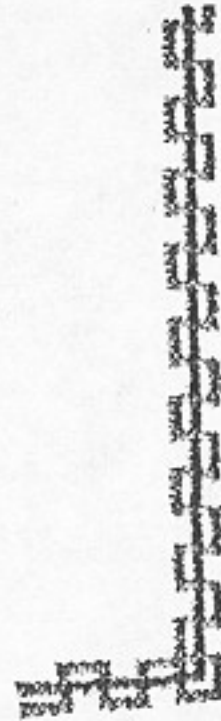
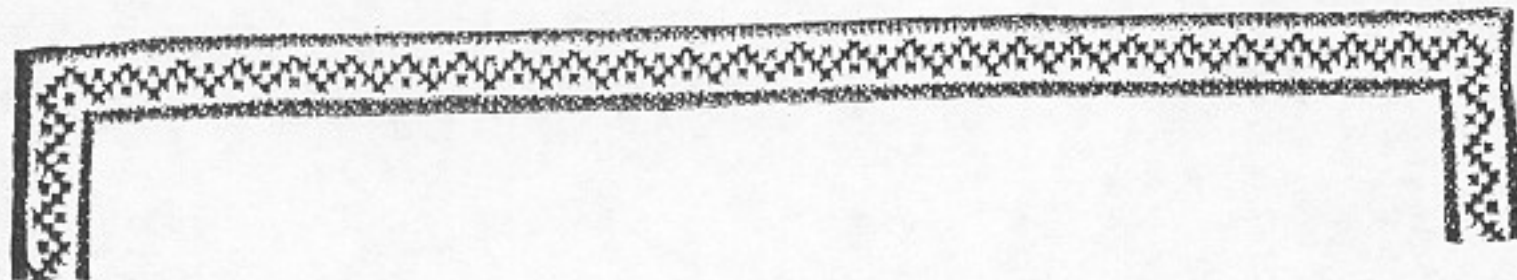


designs. All the knowledge one possesses concerning balance, harmony and rhythm can be well applied at this stage, remembering that the design is to be carried out in cross-stitch and that, "Artistic design is always expressive of its mode of workmanship." The experimental drawing was corrected, refined and transferred to the tracing-paper, and from that to the cross-lined paper, and the work of interpreting into cross-stitch begun. As many lines did not coincide with the squares on the paper, a general readjustment was made, and the design was finally adapted. The face of "Peter," as shown on page 158, is an example of the thought required from first to last. The lower illustration shows a very old sampler which was found in the city of Mexico in the spring of 1903, and is probably 150 or 200 years old. It is curious to note that a piece of cross-stitch embroidery from far-off Smyrna contains a rose pattern very similar to the one on the Mexican sampler, while the same rose is found repeatedly in English work of the seventeenth and eighteenth centuries.

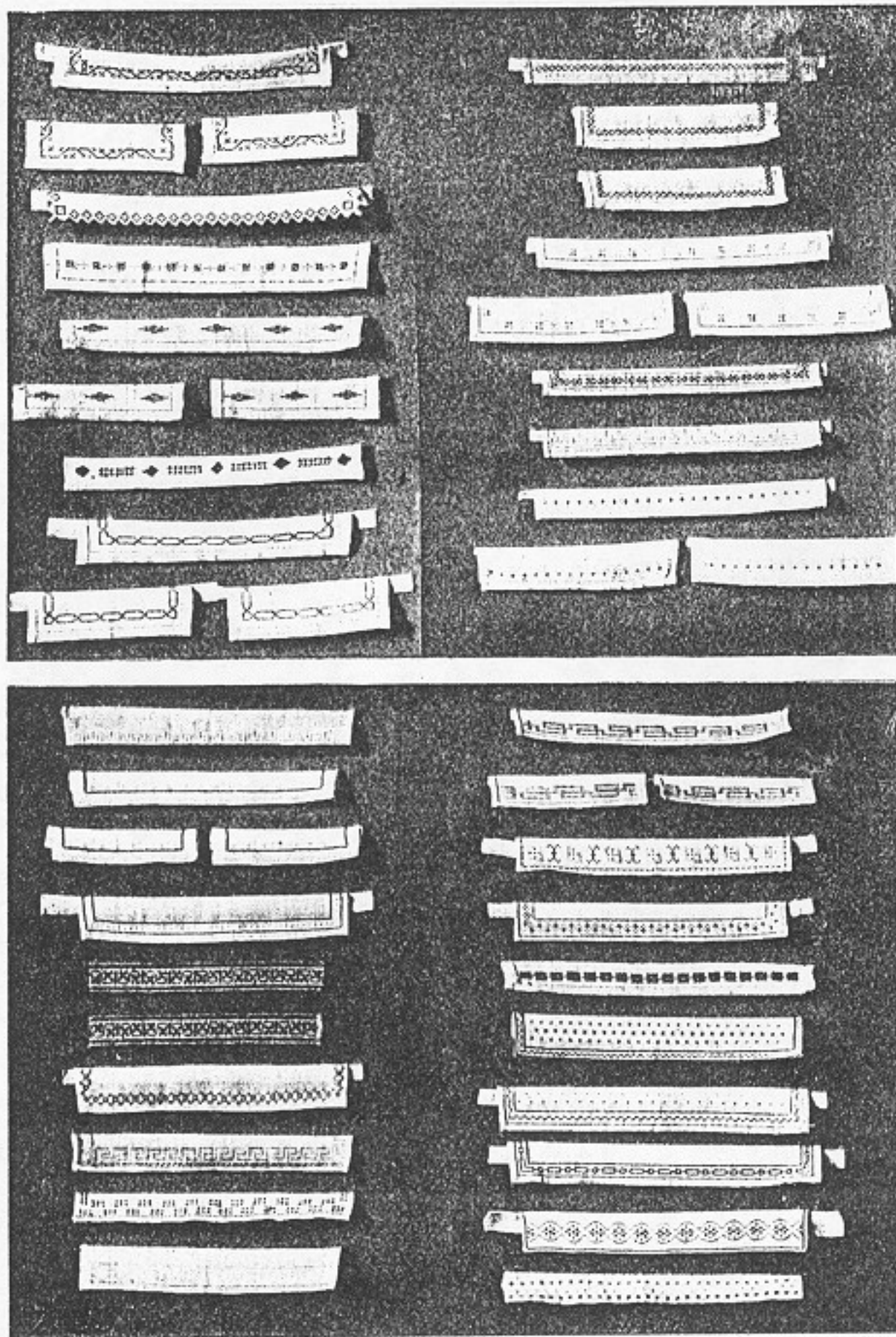


CROSS-STITCH EMBROIDERY as applied to collars, cuffs, and other details of wearing apparel. The very best selection that can be made for such is undoubtedly that derived from geometric units or those of an extremely conventional character. On this page and the following one, of designs exclusively, are shown such work, both in the design and in finished work. The lower border shown on this page is very interestingly adapted from a Japanese unit, suggestive of the trefoil, and showing how the curved outlines of the four petal-like parts have been carried on in the angular cross-stitch. Their forms have been interpreted, not changed. In some cases it will be found helpful to draw in the designs on the cross-lined paper in square dots, filling each little square full, instead of marking in the cross-stitches with the pen or brush, though this is merely a question of which way will be found easier to do. The selection of color is an important consideration,

it being desirable to have the principal parts of a design accented by a stronger or more intense tone. It is generally safe to use the softest tones in the largest quantities, reserving the most brilliant ones for emphasis. If complementary colors are chosen for a design, care must be taken that these are not used in equal quantities, as has been already stated. The scheme may be handled as in any design or painting, either analogous, complementary or self-color — shades of the same color. A complementary color scheme employs two colors, as red and a blue-green, blue and a yellow-red or orange, yellow and purple-blue or violet. An analogous scheme uses colors related by hue, such as red and a yellow-red. As a rule, however, colors contrasting to some degree are best. Some designs are better with margin lines, while others are better without them. Often the effect of a design may be wholly changed by the use of margin lines.



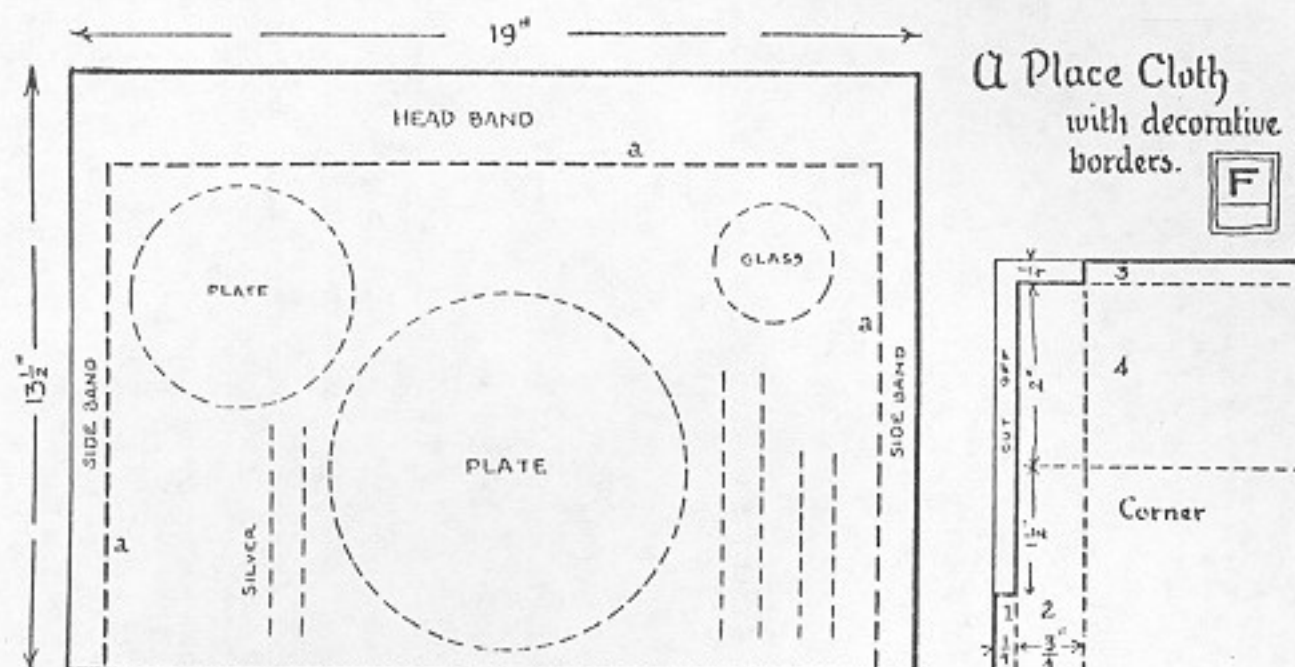
SOME GOOD BORDERS IN CROSS-STITCH EMBROIDERIES



COLORING IN CROSS-STITCH EMBROIDERY. Here are forty-five pieces and sets of work in Applied Cross-stitch Embroidery. These are designed as collars and cuffs for women's garments, and show the great and beautiful variety possible in the use of simple units. No two are alike, yet many are related to a common unit. Here the geometric form is most adaptable; the cross, square, triangle, lozenge, concentric squares, the oblong, separate or linked, the Greek fret, and an unnumbered host suggested by a mention of these, all lend themselves readily to adaptation.

white ground, the white is, of course, the dominant note and the relative amounts of the complementary colors may be more nearly equal. It is well also to remember in making complementary combinations that the more brilliant color should be used in the smaller areas. In any case the colors should be so disposed throughout the design that the design strikes the eye as a whole first; no part should be obtrusive. Very beautiful can these little colored embroideries be made. In any color decoration of costume, the bright colors, used sparingly, have somewhat the effect of gems.

The coloring in cross-stitch embroidery is a problem not easily solved unless one works on a basis of principles. There are three principal types of harmonious coloring: First the monochromatic. In this type the color of the dress goods is repeated in the embroidery, lighter or darker, or both. The second is the analogous type of coloring. In this the colors of the embroidery are closely related to, that is, analogous to, the color of the goods. For example, if the goods were brown, the embroidery might be yellow or orange. The third type of coloring is complementary. The colors used in the embroidery would harmonize with the dress goods by contrast. The pairs of contrasting colors are: red and blue-green, yellow and purple-blue, green and red-purple, blue and yellow-red, or orange, purple and green-yellow. In making the complementary combination one color should be dominant; that is to say, there should be a large amount of one color and a small amount of its contrasting color. If the embroidery is placed upon a

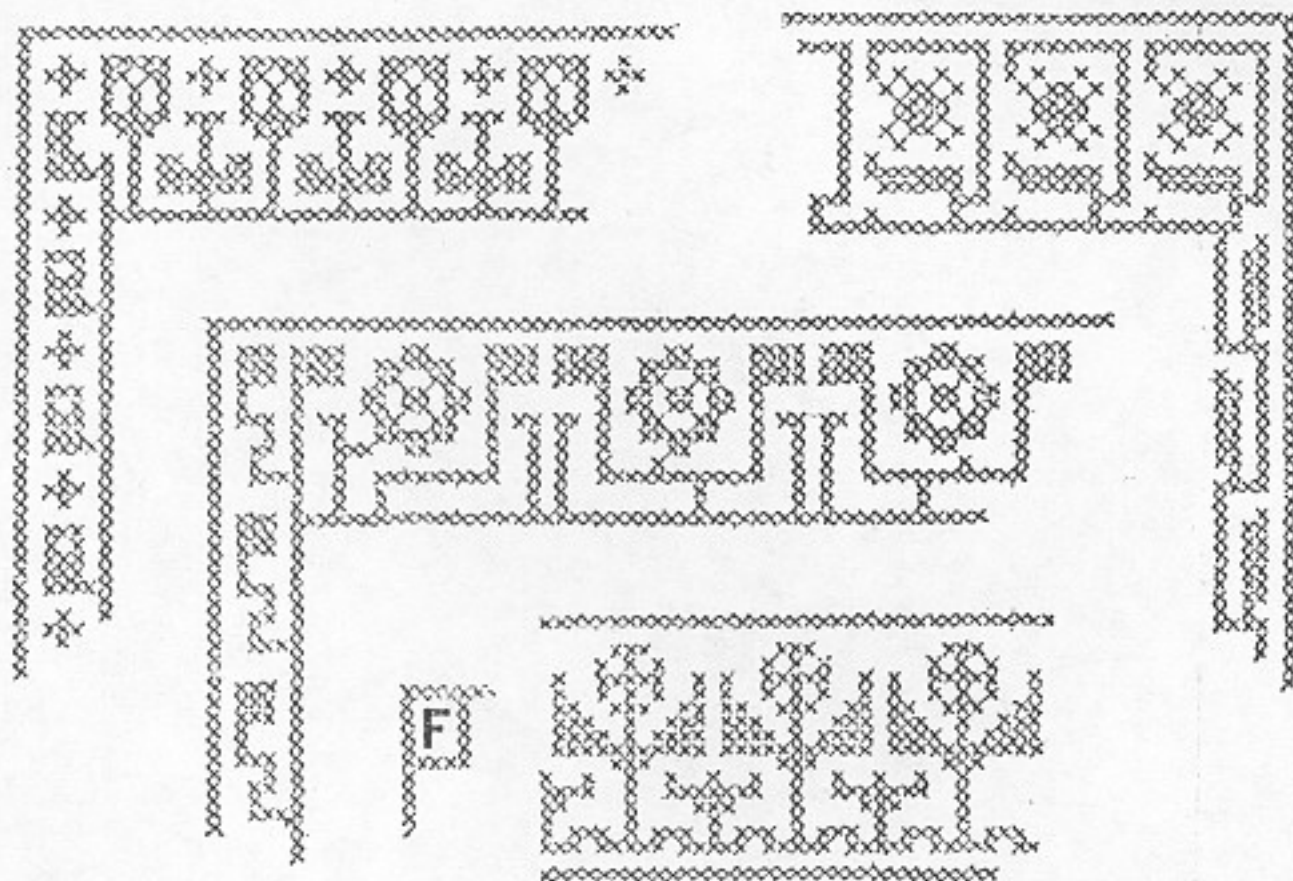


A PLACE CLOTH OR INDIVIDUAL TABLECLOTH, to be worked in cross-stitch. This is a substitute for the various mats and doilies used when the tablecloth is dispensed with. It should be of linen, large enough to contain the plate, bread plate, glass and silver required for one person at a meal. A good form would measure $13\frac{1}{2}'' \times 19''$. Hem neatly 3 sides, as shown by the dotted lines. The ornament at each end should be narrow and may be a "vertical border." The top, or head, should have a wider and richer "horizontal" border. The fourth side should be the selvage, without ornament. The side borders may be $\frac{3}{4}''$ wide, and the head from $1\frac{1}{2}''$ to $2''$ wide. First make a dummy cloth from a sheet of thin, tough wrapping paper, $15\frac{3}{4}'' \times 21''$. Turn under $\frac{1}{4}''$ on the three sides to be hemmed; turn under again for the hem proper, $2''$ at top and $\frac{3}{4}''$ at sides. Plan just how the corners shall be folded, cut, and felled. Note the method suggested at F. Fold over the parts in the order indicated by the numerals. On the upper side of sheet draw pencil lines to show the exact position of the edge of each hem as seen in dotted lines at *a a a*. Sketch out and select your design elements, and whatever these may be, remember that they must be "squared up,"

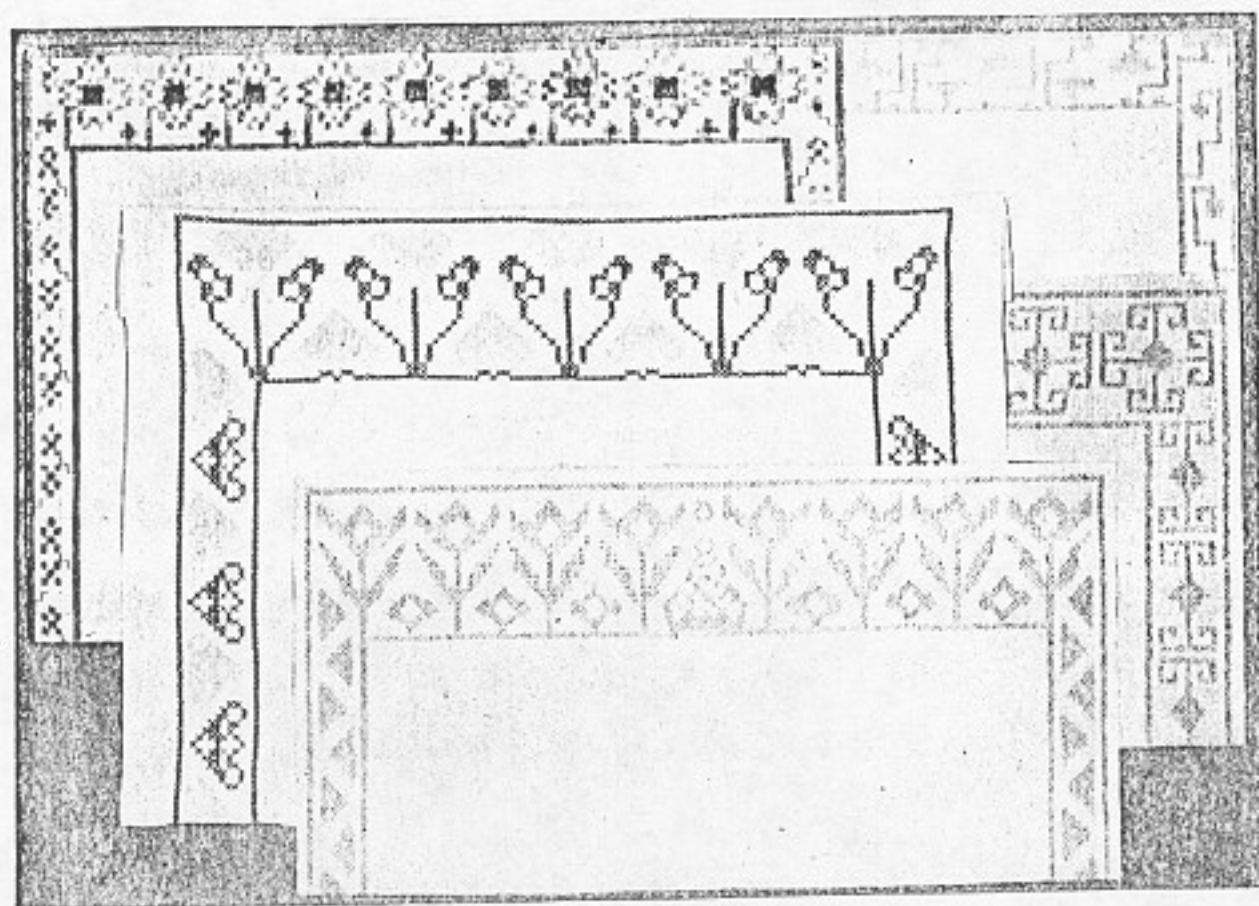
to be worked in cross-stitch. Lay out lightly on the dummy, to find the number of repeats. Make trial sketches on cross-lined paper to see how it will work out in the stitch. Lastly, see that the color is good.

Details for the PLACE CLOTH. With the dummy as a pattern lay out the design on the linen. This may best be done by stretching the linen taut

upon a drawing board, keeping it in place with thumb tacks. Upon this, work delicately with a pencil of the color of the thread to be used in the embroidery. Make not one unnecessary touch with the pencil. The illustrations show



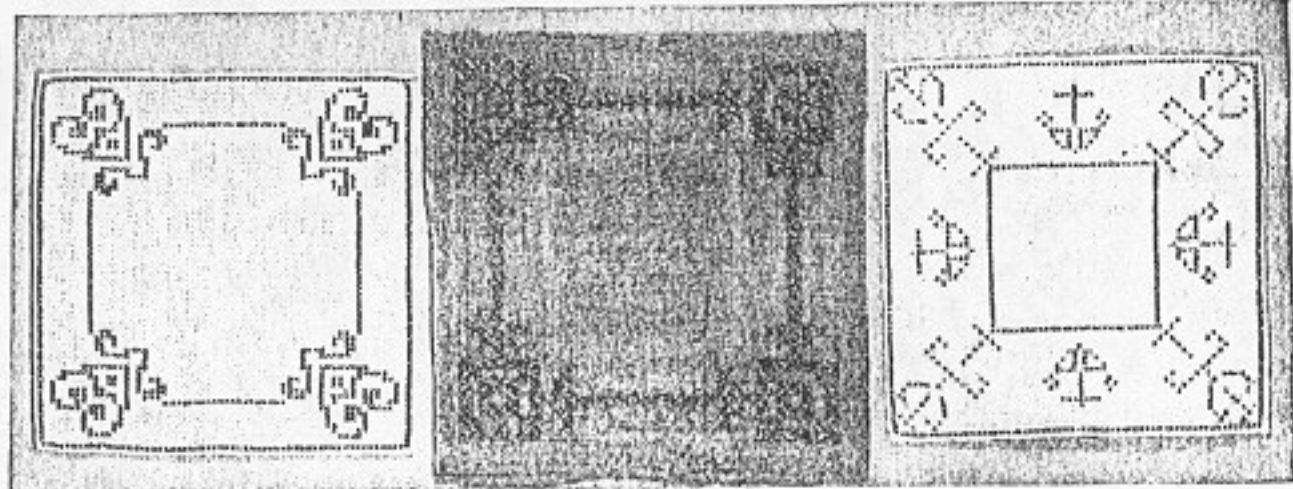
four borders drawn upon squared paper. Three of the designs show the graceful turning of the corner, the transition from the narrow side border to broad head band. These designs are all intended to be worked in two colors, of very low intensity, and of but slight contrast with the white ground. They must not be staring decorations. That is the office of a label—to arrest your attention. These should attract, not arrest. The mere working of a corner may seem a matter of slight importance, but right here lies one of the secrets of good design, successful adaptation.



Examples of good PLACE CLOTHS, worked out by pupils of a seventh grade public school.

The variety in the designs speaks well for the methods taught in this school, wherever it may be. Such work — or any work — is sure to be better for being original. Where doilies are to be used, cross-stitch offers one of the most attractive means for ornamentation. The three shown in the

middle illustration were also the work of thirteen-year-old school children, the patterns made from their own designs, the themes worked out first upon squared paper, and the color schemes carefully studied out by means



a square and these were then sewed together. The spread is made of five principal parts, the center-

piece, which rests on top of the bed, the three flounces, for either side and the foot, and a head piece. The center-piece is the one surrounded by the worked squares. A good size spread for a single bed will measure 6'-2" wide and 8'-0" long. Of this width each side flounce takes up 1'-8", and the center-piece 2'-10". The foot flounce also measures 1'-8" deep. This particular spread had the center-piece bordered on all sides with a strip of 3" width outside of the squares. These num-

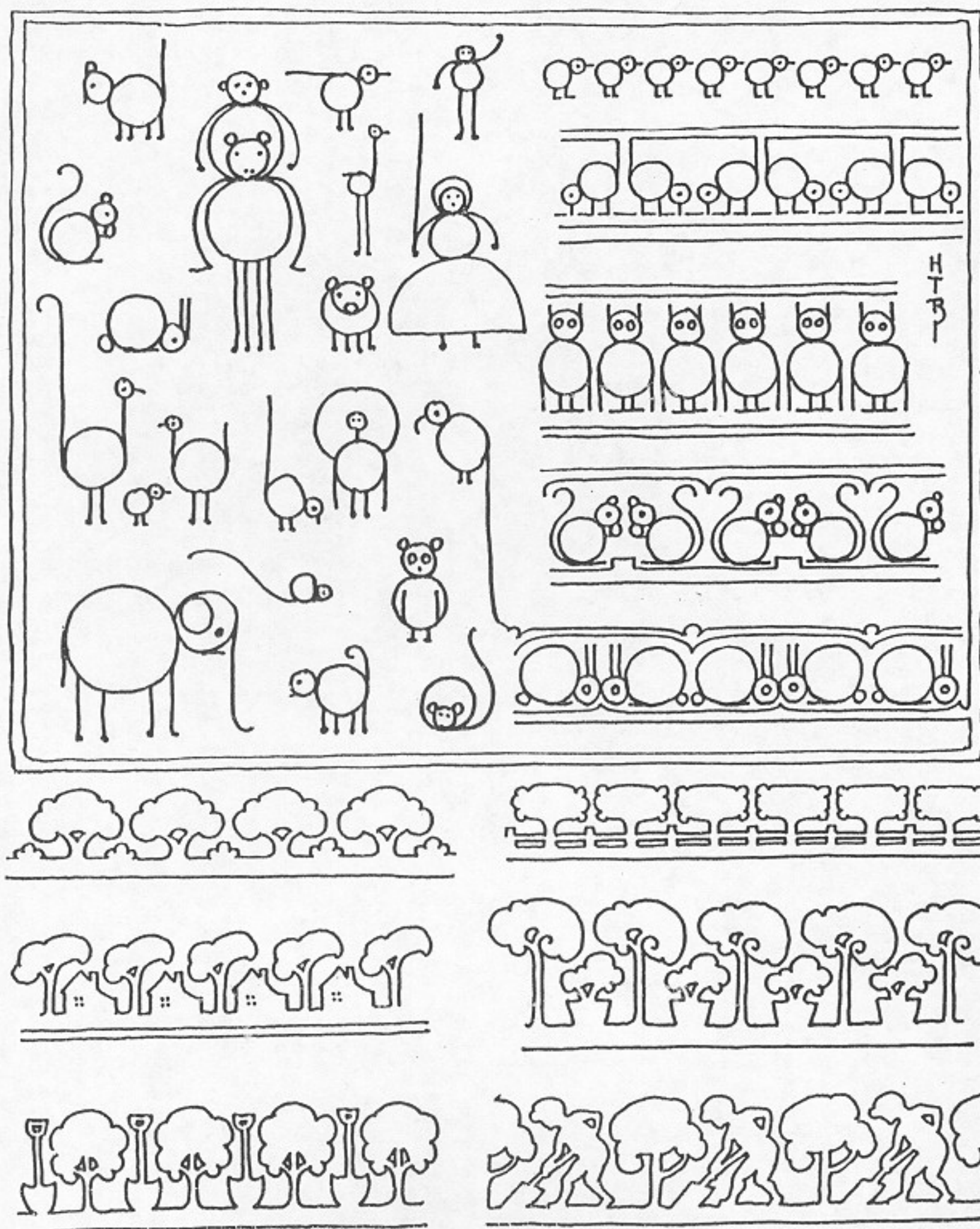


of colored pencil trials. The three doilies show two applied designs of the square, one where the empty space of the center is em-

phasized by the margin lines based on the square, the other where the square itself is made the theme, occupying with equal emphasis the space devoted in the first one to the empty square. The lowest illustration shows some of the squares worked out by children eleven years of age, for the borders of a BED SPREAD. This spread can be made for either a single or double bed, but a good idea is to plan it for some hospital which has a children's room. Each child worked

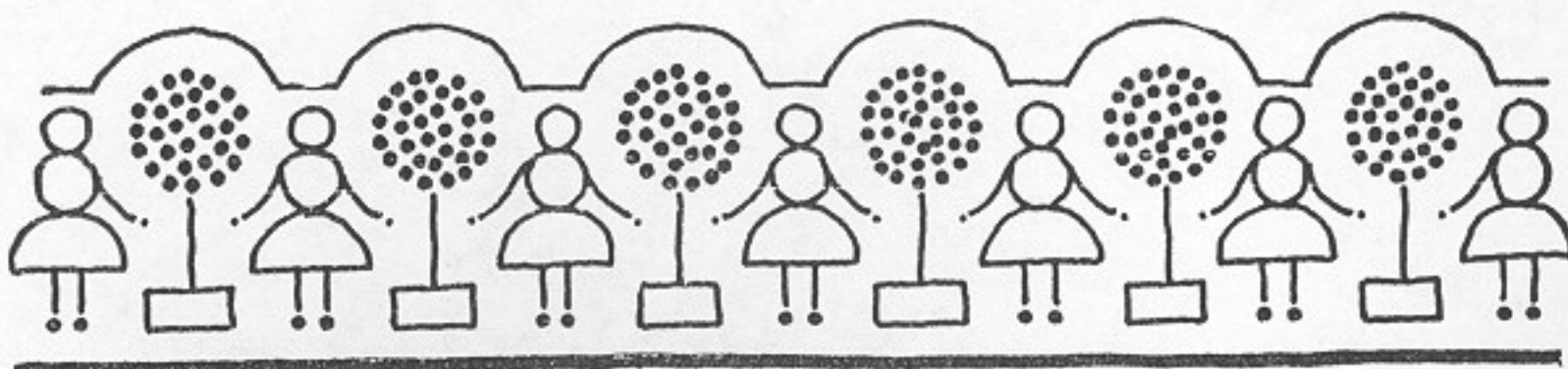
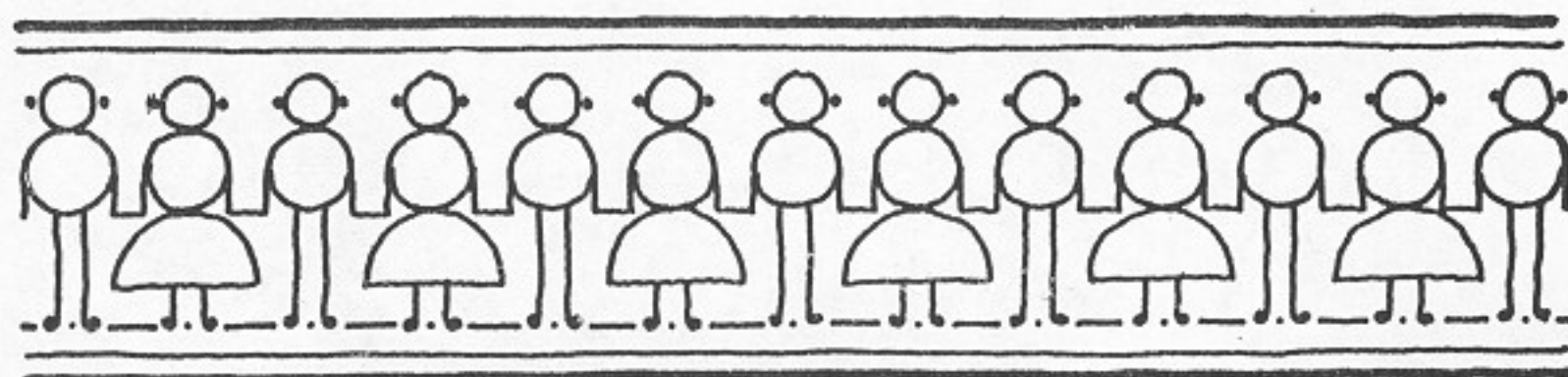
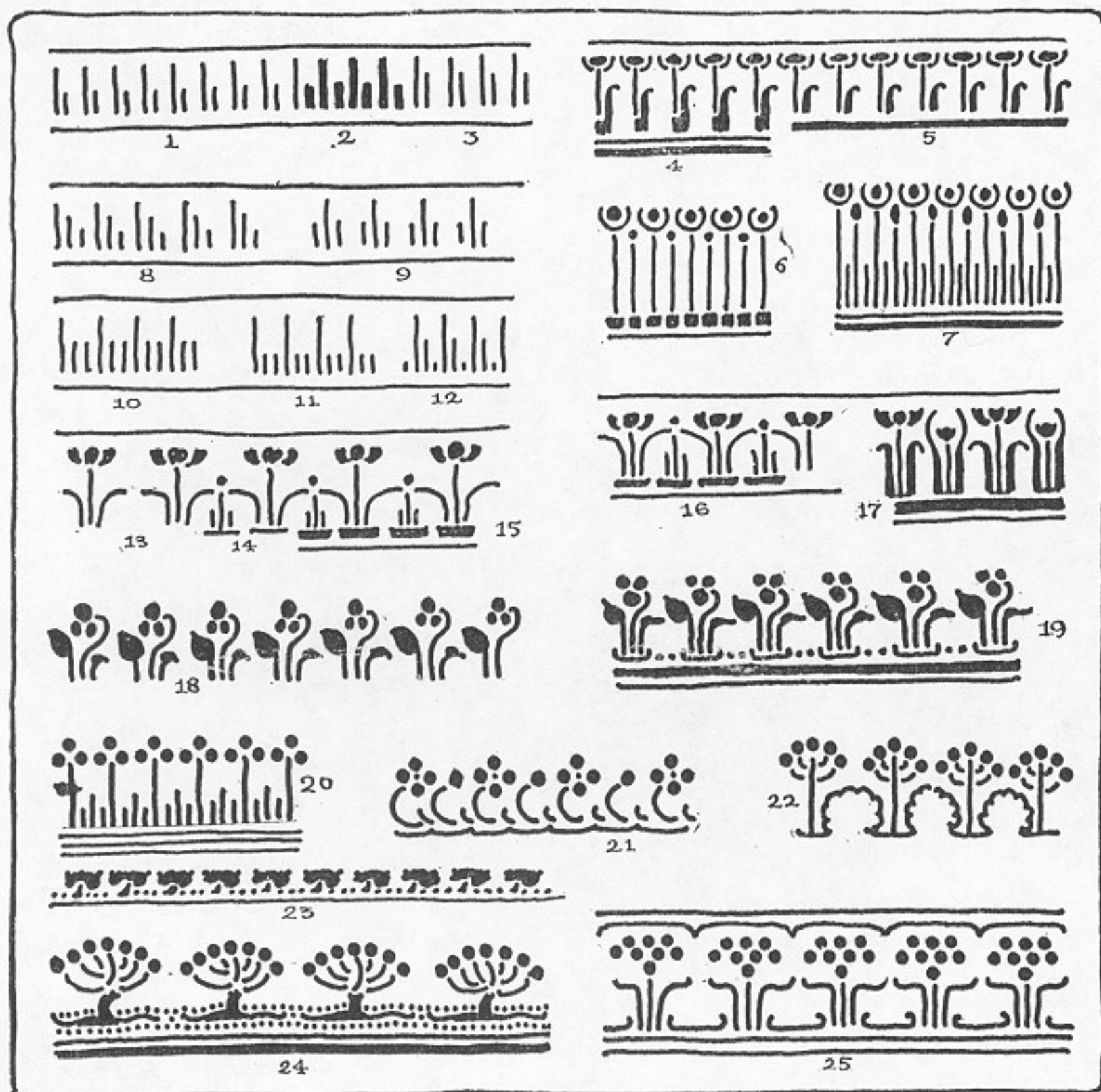
The units used in outline stitch may be infinitely varied but should be consistent in character throughout each design. On this page,

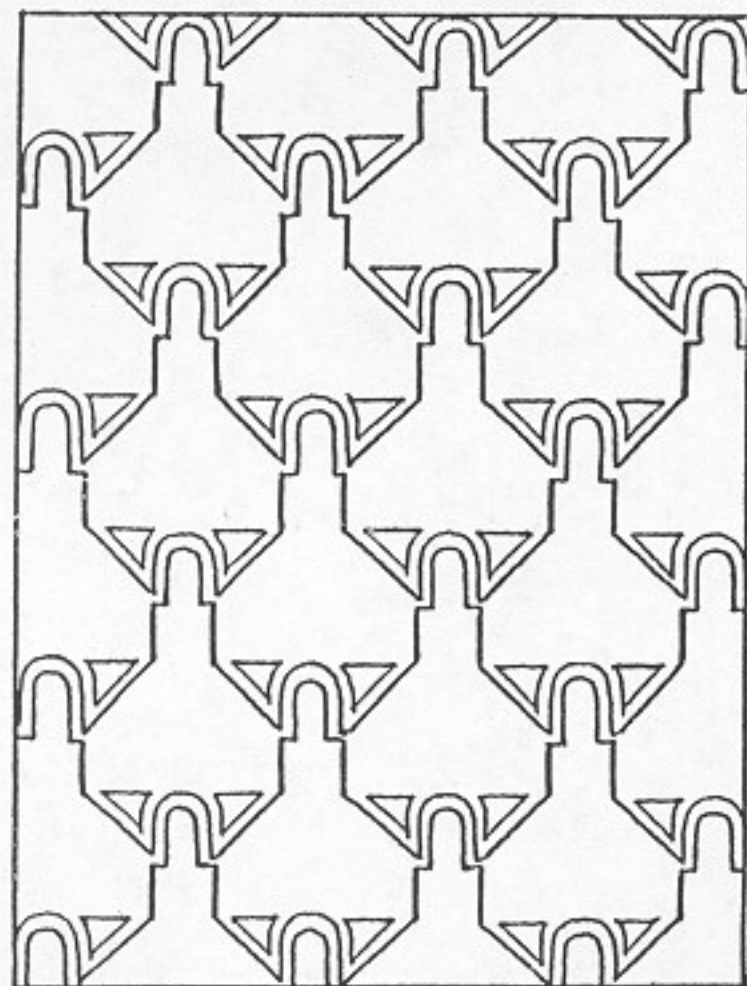
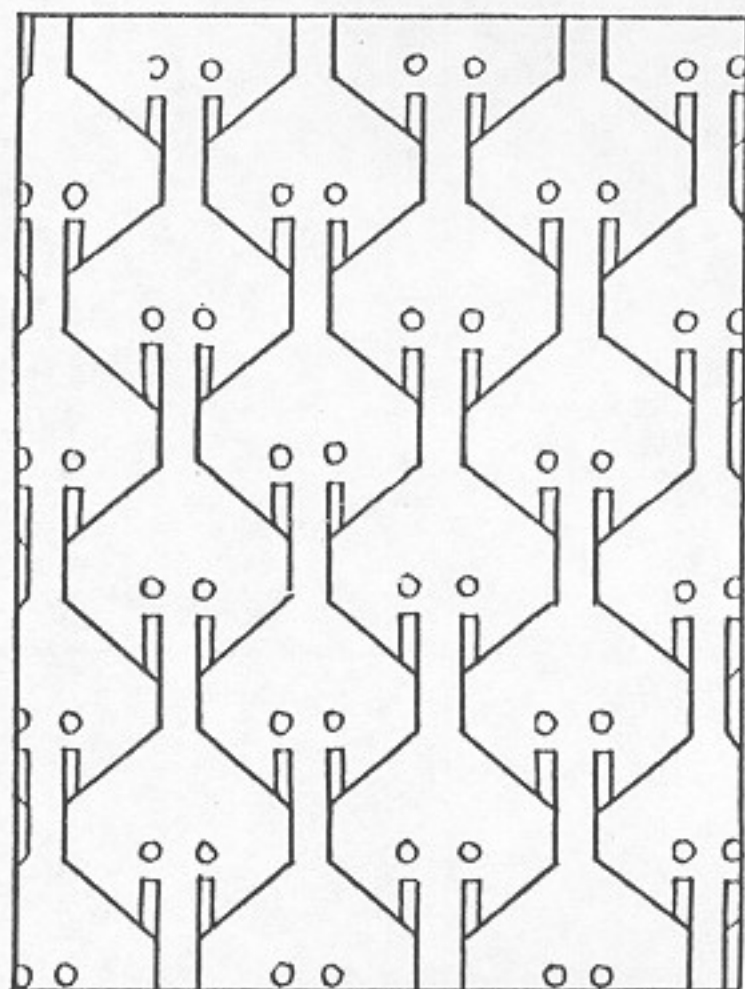
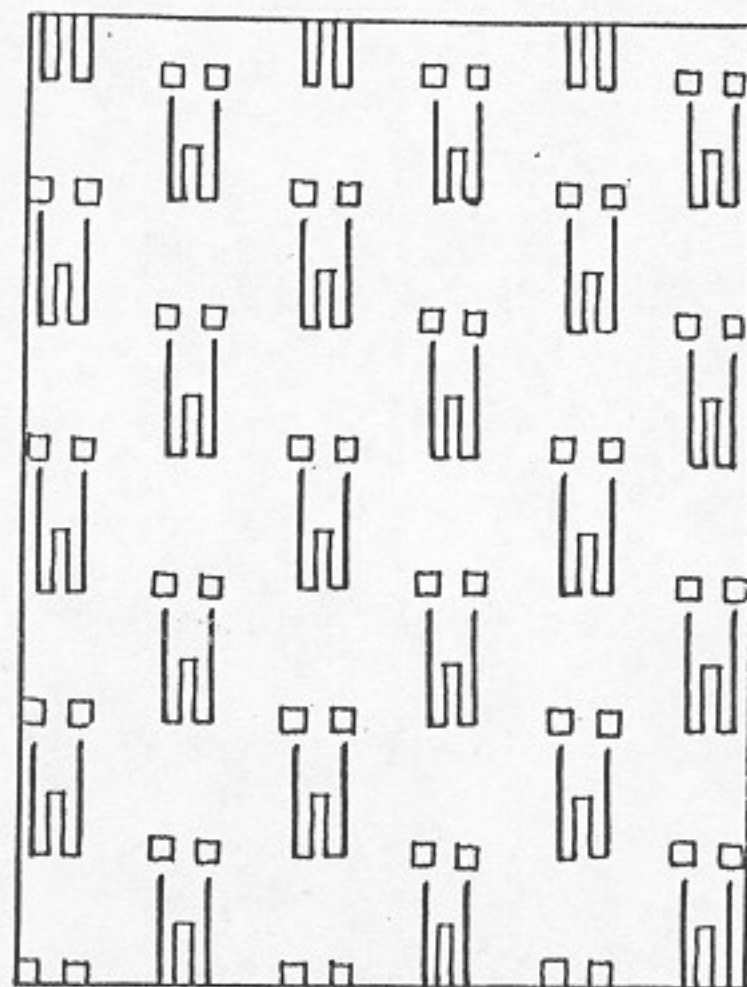
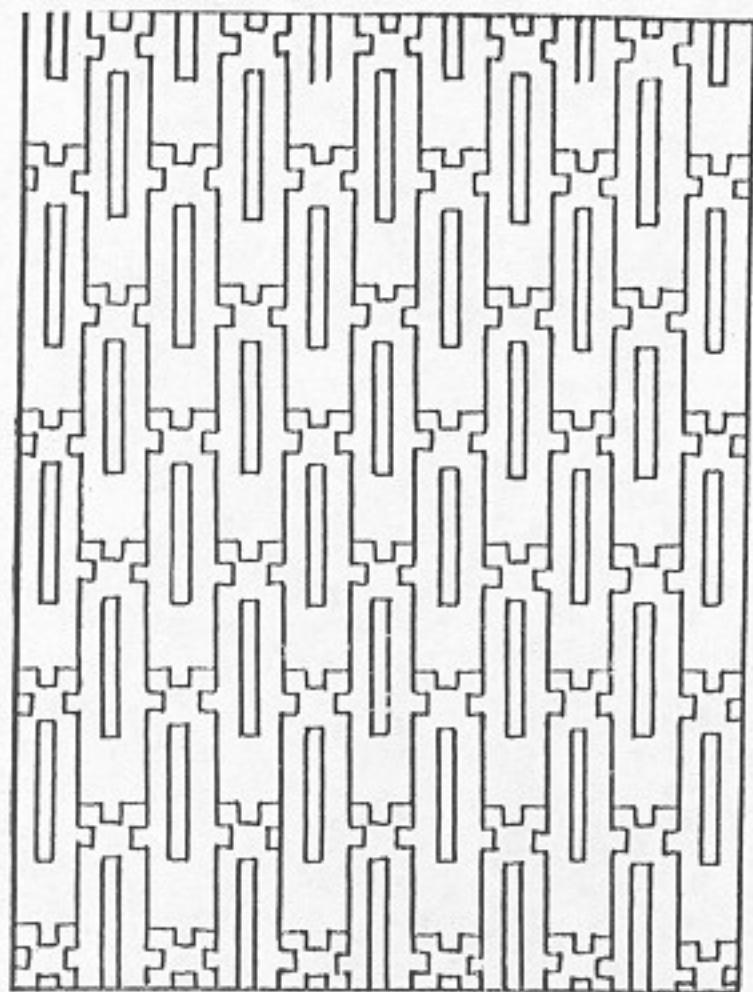
this page have natural motifs, while those on page 168 are purely geometric in character with vertical, horizontal, and oblique lines



for instance, the units of the upper part are made up of circular curves, straight lines, and dots only. Other examples of the same kind are shown on page 167. The other designs on

only. The upper part of page 167 gives further suggestions for embroidered patterns into which solid embroidery is introduced. These illustrate also certain principles of design dealt



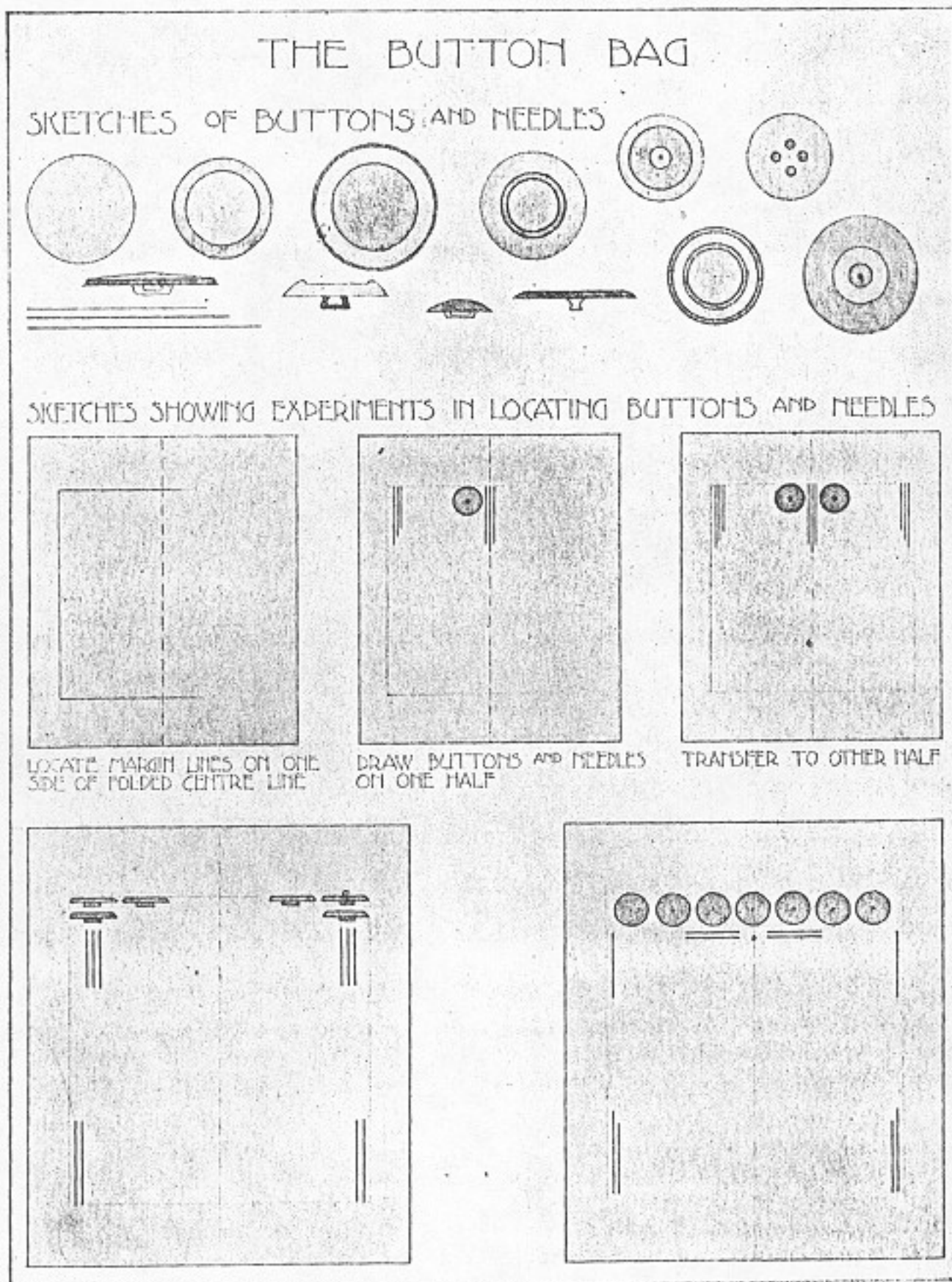


with in the chapter on "Decorative Design." They illustrate the various effects of heavy and light units, units closely packed or spread apart, and of units having a similar or a contrasting character repeated with and without marginal lines. Such patterns are good for the ornamental bands upon table runners, sash

curtains, and embroidered bands for wearing apparel. The units must be so grouped that the eye is conscious of a pleasant movement throughout the design. In a good border one is never tempted to count the spots; each unit is so related to its neighbors that the eye is gracefully conducted from one unit to another.

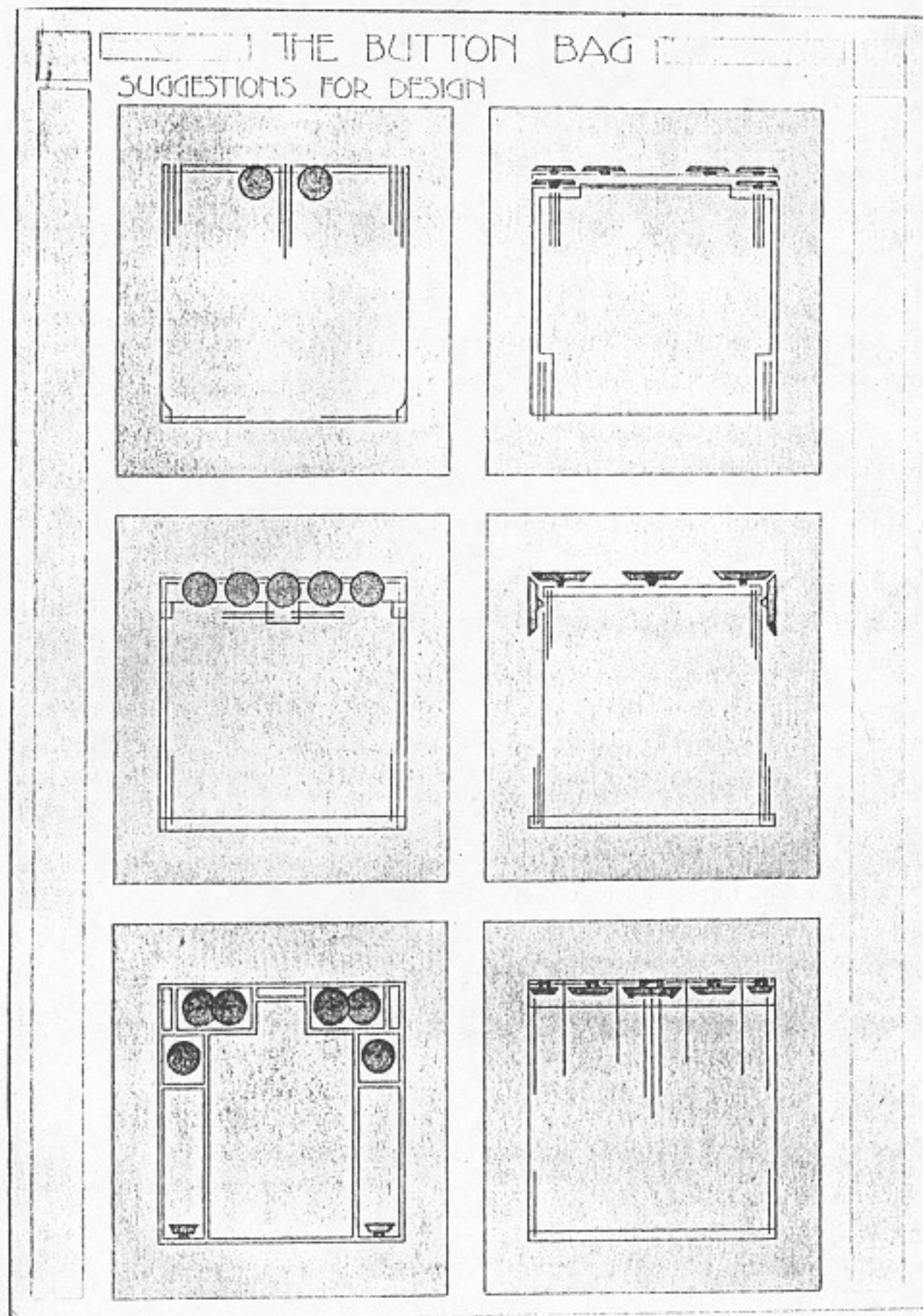
A BUTTON BAG, TASTE-FULLY DECORATED. To make the button bag, the general directions for the washcloth bag will suffice, though this need not be lined like the washcloth bag. This page is concerned mostly with its decoration, which in the picture is marked by fitness to purpose, the units of the design being taken from what the bag is meant to hold, buttons and thread. Needles might be added.

Make careful drawings of the buttons you like best, selecting those which are simple and attractive, not those cast in metal nor studded with cheap glass gems. Cut several pieces of paper of the exact size the bag is to be. Fold them vertically in the center. Allow wide margins at top and bottom because of the cloth puckered by the drawstring, and the weight of the buttons which will crowd down the lower sides out of sight. Distribute your centers of interest so that one shall be chief. In this particular problem it would seem well to locate this near the top, and perhaps in the center, horizontally, or it may be in the center of the available space. Try it and see which looks the better. Now sketch in one or more buttons where you think they will look well, and maybe add an effect of the needles in the shape of horizontal lines in pairs or triplets, or more numerous. Keep all within a good-sized marginal space. If you employ lines to suggest the threads, see that they connect the buttons one with another and run through the eyes of your needles, if you develop needles as a part of the design. Shall we show the buttons edgewise or full-face view, or a combination of



A BUTTON BAG: SUGGESTIONS FOR THE PARTS THAT GO TOWARDS MAKING IT

both? Such questions will rise up for solution. Do not overload the design. Keep the interest well centered in one locality. Do this work on one half of the paper, to right or left of the vertical fold. Then fold on this center, with the drawing side folded in on top, and rub on the back or upper side with the unsharpened end of the pencil, which will transfer the drawing to the other half with no bother of tracing paper. Line in the faint impression, and you can see how the whole balances. Transfer the whole design to a sheet of white drawing paper and prepare for the color scheme, which should be simple,

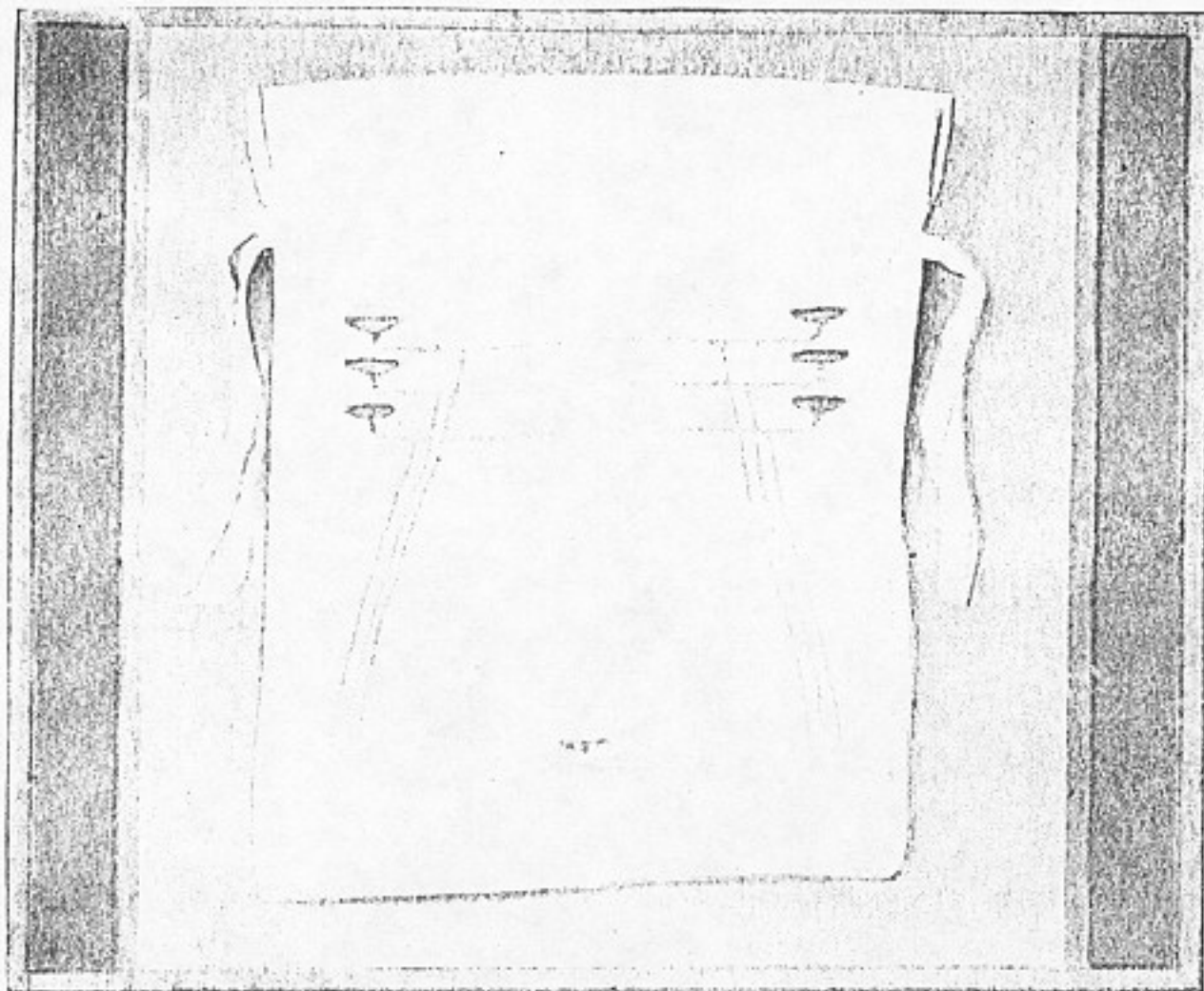


a good one being of an analogous harmony in green and green-yellow, thus keeping close to the prevalent yellowish tone of the linen of the bag. When you have worked out the color to your satisfaction, so that it arrests the eye as a harmonious and restful whole, it may be transferred to the cloth of the bag by tacking it over the cloth with thumb tacks, and using a sheet of carbon impression paper between. The painted design may be embroidered in outline, using embroidery cotton or silk. One effective way would be to paint the buttons on a design such as the one shown, and embroider

the thread lines only. In painting such a design, care must be taken to see that the color does not run. The brush must be kept rather "dry," that is, do not have it full of color; use only a little. Colors made of aniline dyes would answer for this sort of painting. It would need but a few grains of the dye powder, dissolved in hot water, to give an ample quantity.

The designs upon page 169 and this page illustrate a principle worth keeping in mind; namely, that the ornament applied to any common object should have some relation to the character of the use of the object. A design made of abstract spots equally appropriate to all sorts of conditions is peculiarly appropriate to none, and therefore usually falls short of being a satisfactory form of enrichment. In this case, buttons, threads and needles are the only motifs in the designs. The superiority of these designs over those shown in the plate on page 171 now becomes evident. The button bag designs were made by

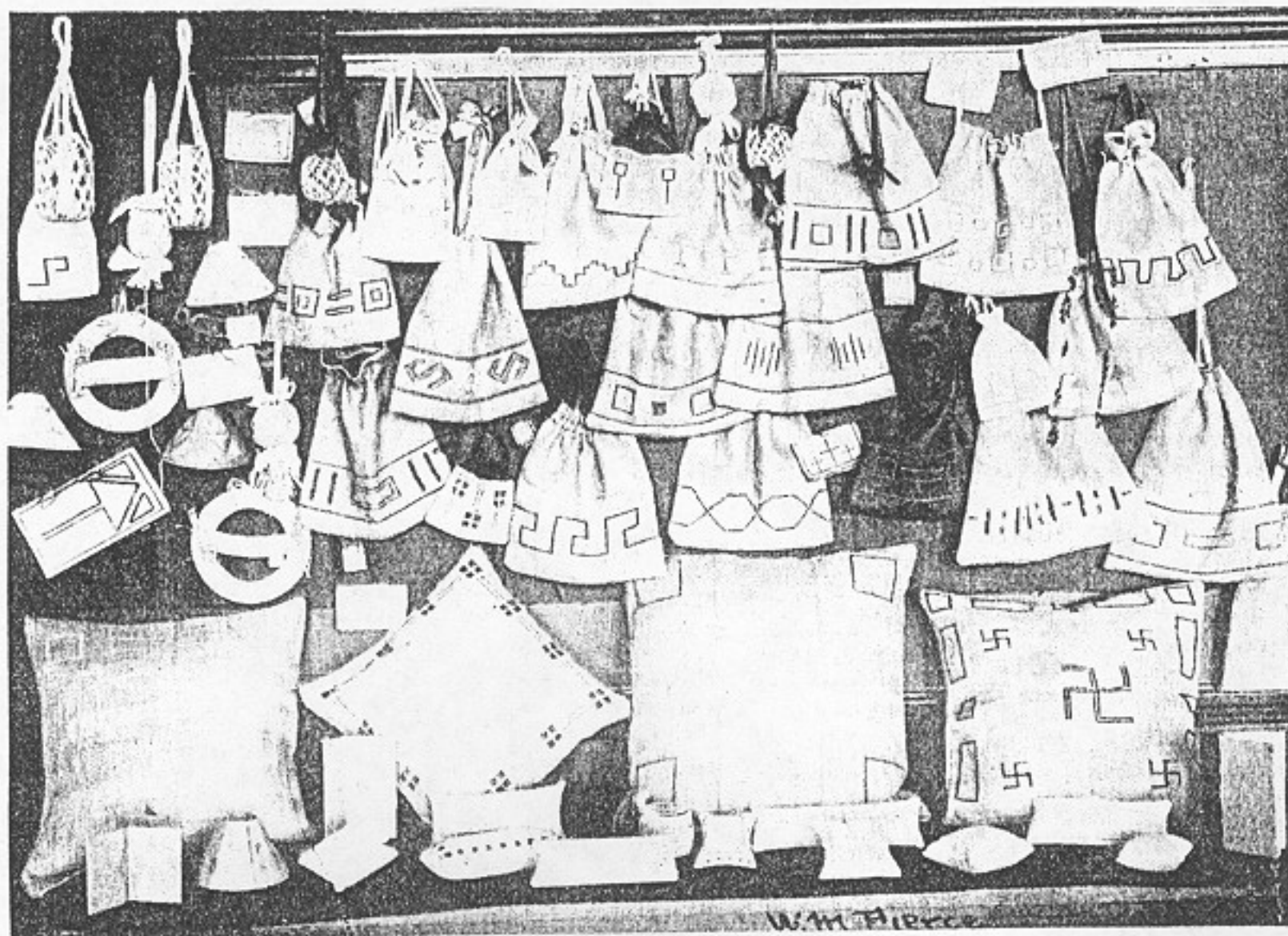
a well-trained designer. The objects shown in the other plate were designed by grammar school children. Considering the fact that the children were of but ten years of age on the average, the work is excellent if not ideal. These school bags might have had ornamentation related to their purpose. A border of interwoven letters or figures, or of conventional books, or of objects constantly in use in the schoolroom properly conventionalized and grouped would have been not only more appropriate but more beautiful than the detached abstract units the children were al-

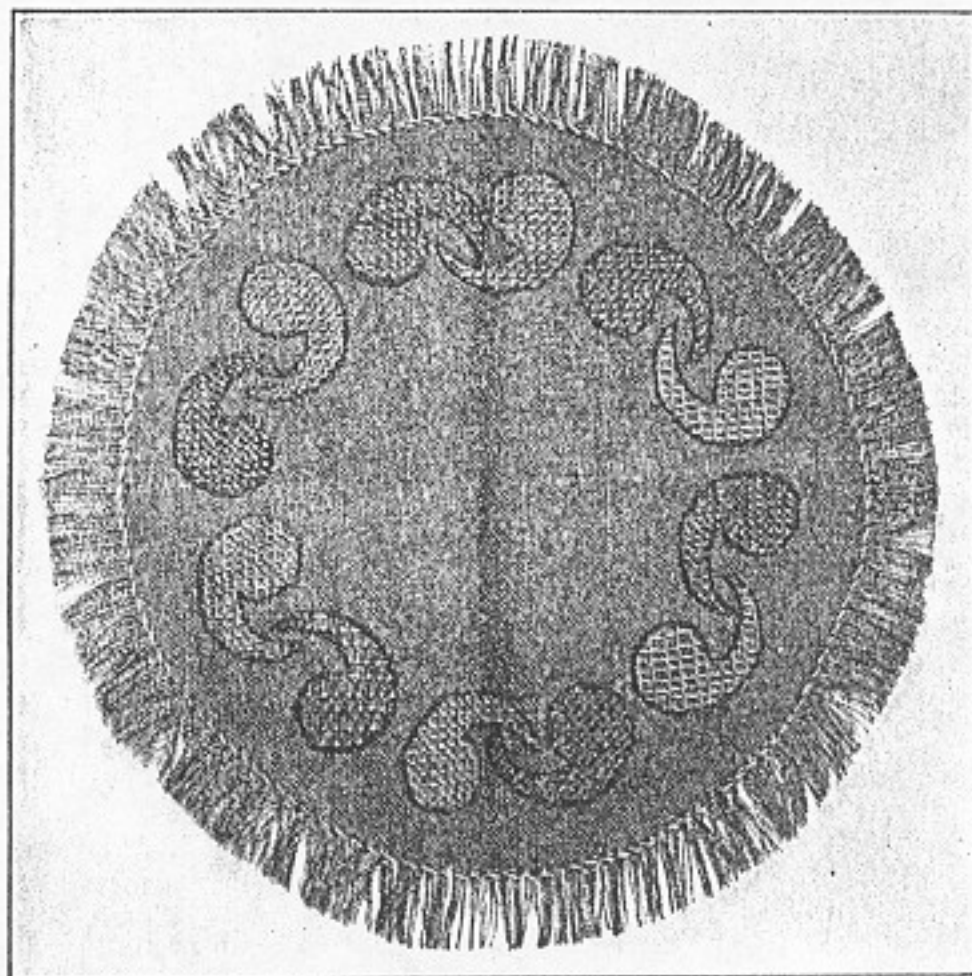


lowed to use. These designs by the children also illustrate another common failure in amateur work; namely, the failure to secure harmony of effect. In almost every case the

in handicraft work of every sort lies in the word "Adjustment." Part must be happily adjusted to part, in form, in color, and in position as well as in character.

contrast between the ornamental detail and the ground upon which it has been worked is too great. As a result, the lines of the ornament attract too much attention. You think of the ornament with a bag underneath it rather than a bag well ornamented. Another element which aggravates the inharmonious condition in many cases is lack of scale. The ornament is too bold and strong for use for so small an object. An object to be held in the hand does not require an ornament which announces its presence by shouting aloud. The secret of producing satisfactory effects



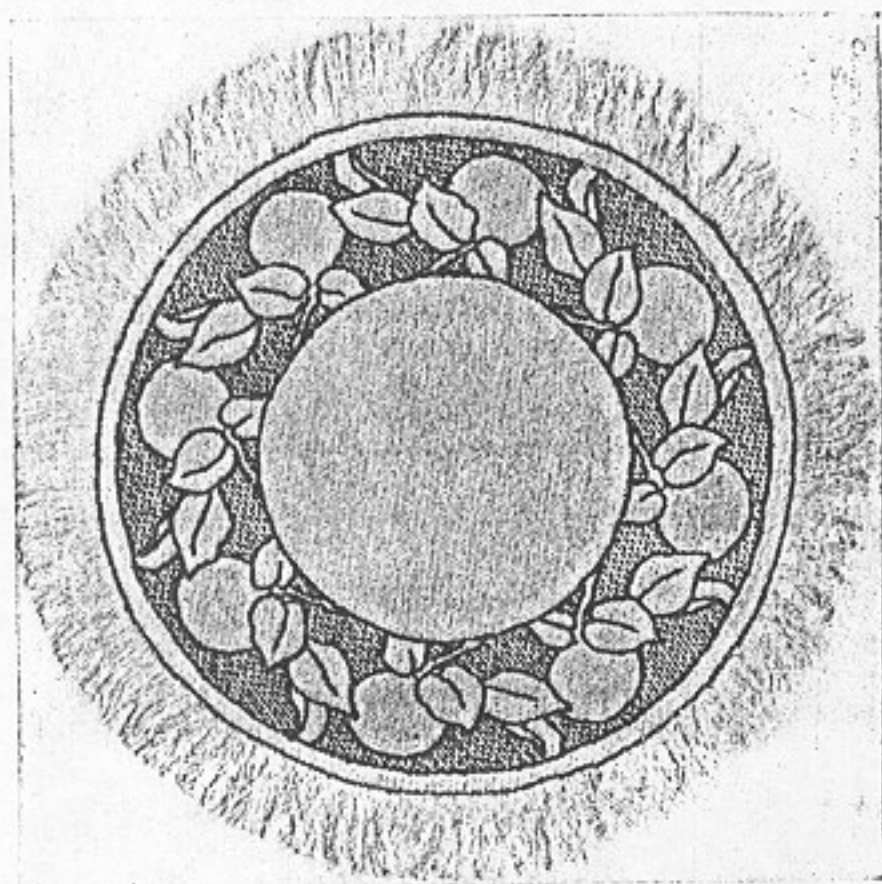


BURLAP MATS, EMBROIDERED WITH LINEN IN OUTLINE STITCH. Burlap, after its discovery as a decorative material, soon offered a limitless field of usefulness. This includes mats and cushions destined to exposure to the weather, as in the canoe, on the porch table or at the summer camp. In fact, in almost any situation where durability is the end in view, burlap vies with leather in its wearing qualities.

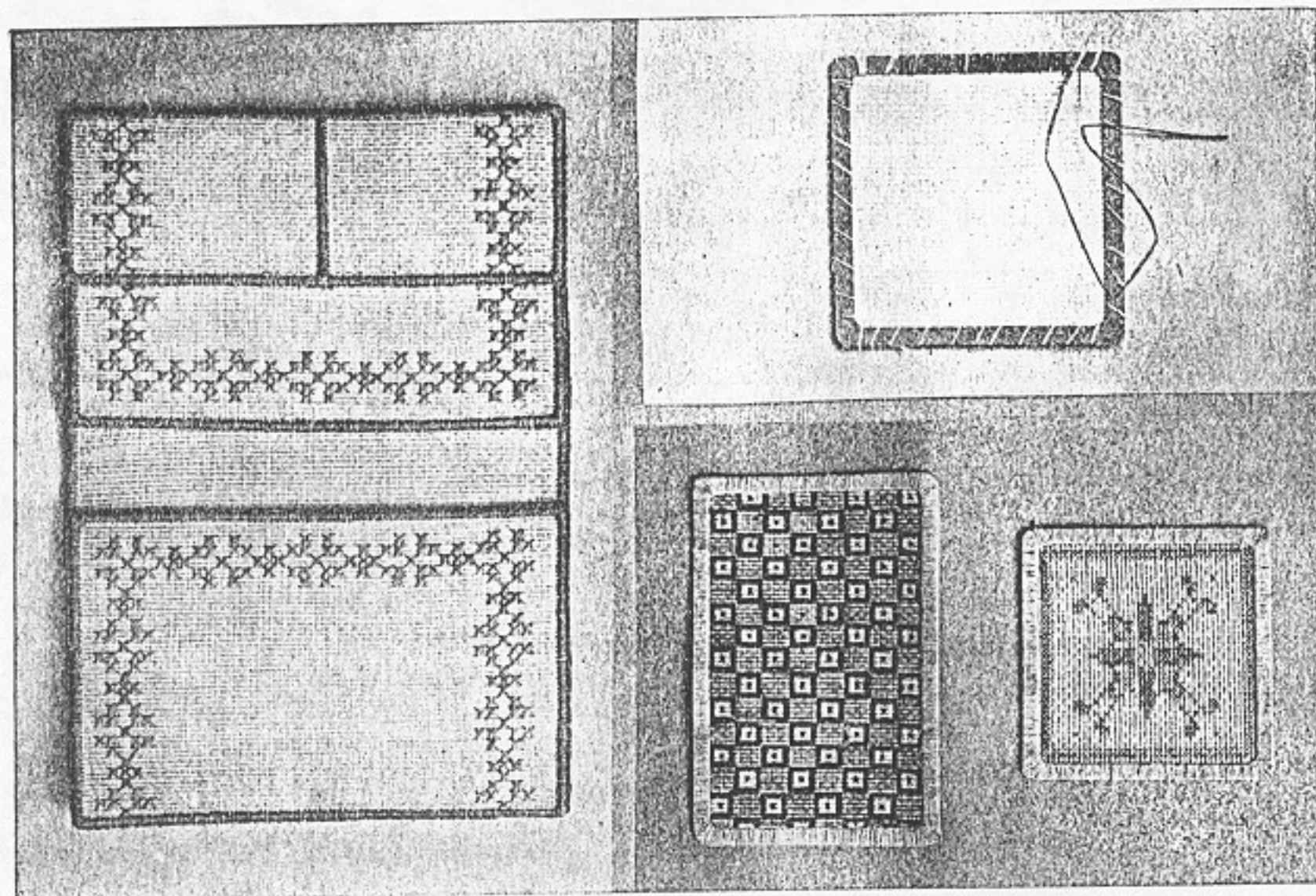
That shown in the upper illustration is made of a burlap with a green-yellow ground on which is worked in outline stitch a circle of units derived from that useful part of written speech, the comma. How appropriate for a set of chair cushions for a Reception Room! And why not other designs made with the punctuation-mark family as a prolific inspiration? The exclamation- and interrogation-points surely offer rich promise. This mat was made by striking out the circle for its margin and working this in outline stitch, the rope-stitch form being used. There is a double line, the outermost being of blue and black, the inner of yellow and black. The outside circle for the fringe may be described at this point, though it is full as well to wait until the design is completed. This should be carefully studied out, full size, on manila paper, traced, and applied to the material. If you attempt to tack down the paper pattern and work through it, the task of removing

the paper from the small squares of the stitch will prove tiresome, to say the least. This pattern was traced and worked upon the burlap, the body of each unit worked with a simple outline stitch crossing at right angles, caught where the threads cross with a small tight stitch of the complementary color; one-half the units being done in yellow, caught with blue, the other half of blue caught with yellow. The blue used is the more intense of the two. The last step was the fringing out of the edges. The lower illustration shows another method of treating the burlap. Here the decorative band has the design worked in outline stitch, with the ground about the figures tinted a darker shade of the same hue. The stitch employed to outline the figures is here done with a coarser linen, laid on and caught down with strong black linen thread. The burlap is a green one-third

neutralized by the admixture of red, and of low intensity. The dark part is stained a shade

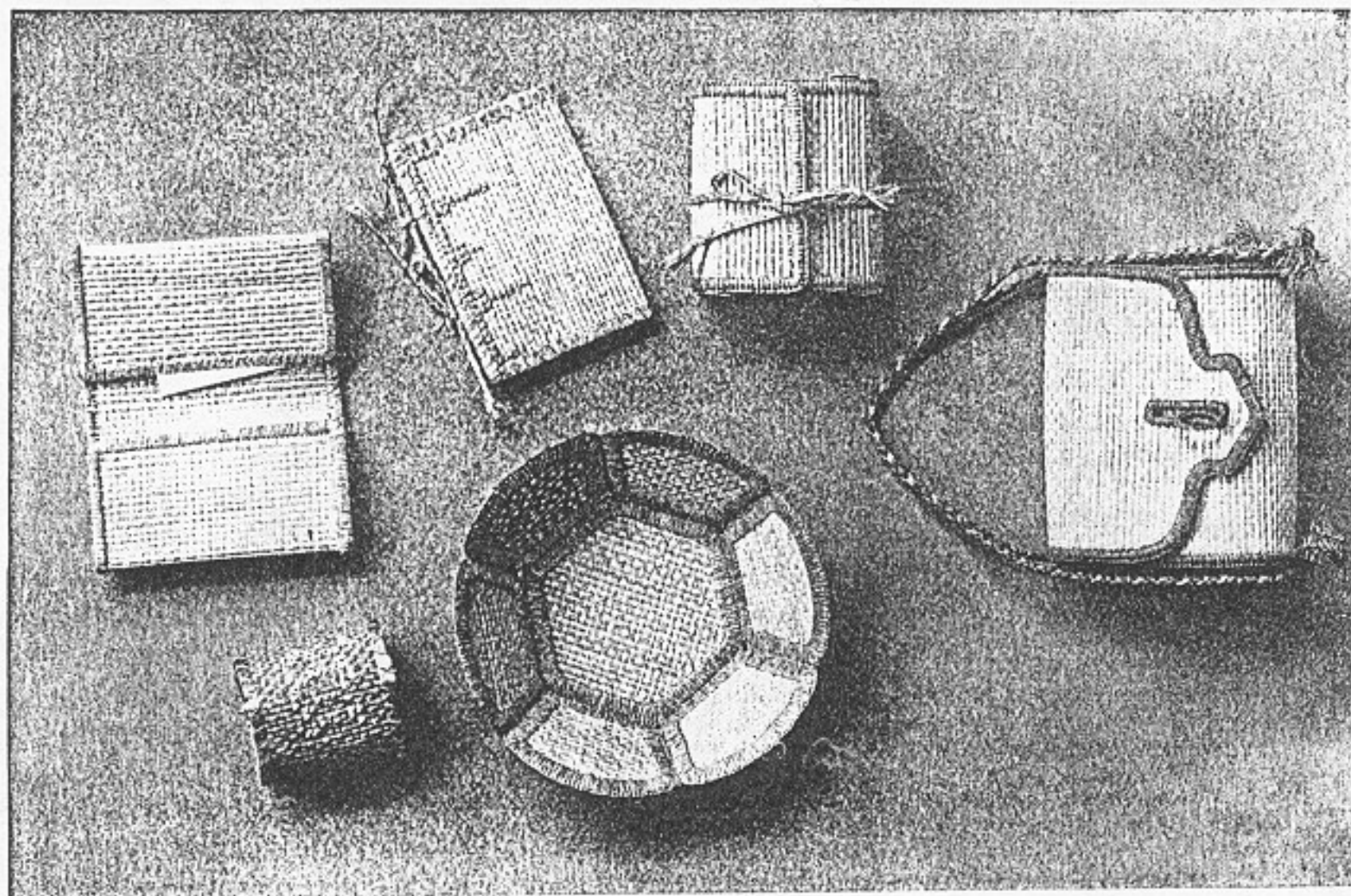


darker of the same hue. This might be varied by tinting the surfaces of the objects a hue suggestive of their color. What a fine opportunity to produce a set of such mats, showing the commoner table fruits of the year. For winter you might design a border of bananas or another of oranges. For summer or fall, use the home fruits.



Objects made of TILO MATTING. Tilo is a woven material somewhat akin to burlap in the color effects to be had from it. It is a soft, pliable matting of checker weave made from the rolled shavings of the Japanese fir tree, in the natural wood color. It readily absorbs the tube dyes that mix with cold water, and so is quickly colored. It can be made into mats for table, desk or pantry, needle-books, napkin rings, boxes, baskets, portfolios, music rolls, porch cushions and fire screens. Raffia is used for working patterns into the Tilo. All kinds of needle-work stitches, lace and weaving stitches and macramé knottings can be used. With it the very little folks can make tasteful and attractive articles for holiday gifts, such as mats, card cases, napkin rings and needle-books, always, of course, under instruction. The older person of fine taste will find in it a source of endless delight. The articles shown in the picture are as follows: upper right-hand object, an unfinished mat, showing the use of strawboard edge for the mat border; lower right-hand object, such a mat, completed and decorated with raffia weaving; beside it, a checkered mat made in the same way, but decorated with

a pattern drawn in water colors. (In large surfaces, dyes are much to be preferred.) Left-hand half of picture, a portfolio made of Tilo and decorated with a design in raffia. There are several devices employed to keep the edges of these mats from raveling, among them being the use of the cardboard frame or edge-form, as shown, over which the raffia or strands of the Tilo are bound, and this edge is glued to the mat or caught with a few stitches. Machine stitching may be used to prevent this raveling. Strands of the Tilo are a yard in length and of a thickness which makes them admirable for braiding. The ravelings may be used for braiding to be sewn into mats, baskets, etc. On account of uniform thickness Tilo matting strands can be braided with much less difficulty than raffia. When a strand is dampened and unrolled it makes a good ribbon to provide binding for a needle-book, napkin ring or other articles. The picture on page 174 shows several finished objects, made in the public schools of one of the cities of the Middle West. As the work of grade children these are remarkable instances of thoughtful planning and nice workmanship. Here are shown a card case,



a needle-book, pin roll, purse, napkin ring and card receiver, or work basket. Another way in which to finish the edges and keep them from raveling is here shown, the use of the oval pith-edge material. This is wound with raffia in the present case, and the resulting edge is attractive and durable. A very familiar article might be made in this way, a checkerboard. The squares might either be painted on in dyes or water colors or woven in raffia of the dark color needed for the "black" squares of this ancient game-board. A folding backgammon board is another game which would lend its peculiar triangular marks to decoration in color in this medium. The boy who likes to experiment with form, who tries with splendid courage to fashion a suit case, a hand bag, or a tool bag, such as the carpenters in England use, will find in Tilo a rich storehouse of possibilities. Perhaps the most richly suggestive of all is the screen, mentioned above. In whatever height this is made, for actual use by the fireside, or in miniature, to shut off the glare of the lamp from an invalid, it offers boundless possibilities for beautiful design in the raffia or Tilo strips. There is about matting of the

Oriental order something especially appealing, as it is one of the things foreign which anyone can afford, and which is at the same time beautiful and durable. Matting has been the chief household furnishing for the barbarous and savage peoples from time out of record or memory. Our American Indians so furnished their wigwam dwellings, and it was upon mats that the kindly English settlers found them lying in the stress of the great small-pox plague. Without their mats it is difficult to imagine the East Indian, the Chinaman, or our polite western neighbors, the Japanese, from whose land comes the Tilo matting. Wherever an effect of summer coolness is desired, the mat has abundant excuse for being, and where most used is most attractive. In learning to make Tilo matting you are mastering one phase of a world-wide craft as old as civilization and indispensable to the human race. The very first woven things were probably mats made of the long leaves of grass or of rushes. The Japanese weave crates of bamboo, the Arabs hampers of palm leaves, the Indians baskets of ash and willow strips, and snowshoe fillings of green-hide.



The two hand bags on this page are two different styles. One is similar to that of a music roll; the other more like an old-fashioned carpet bag, or a modern school bag. The first is adapted to anything that will roll, like sheet music, or manuscript, or cloth of any kind. The second is adapted to stiff things, like books and lunch boxes.

In making bags, the color problem deserves close attention. In the first place the color of the material should be rather dull and unobtrusive, otherwise one soon becomes tired of it. In the second place the additions in the form of ornaments should harmonize with the struc-

tural material. If the material is rather dark, the ornament may be slightly lighter; if it is light, the ornament may be slightly darker. In either case the contrast should not be too great, otherwise it becomes tiresome. The color of the ornament would better harmonize by analogy with the structural color or be a soft tone of that color. If complementary tones are introduced at all they should be in very small brilliant touches like jewels added to the general color schemes, or else of very low intensity that is dull and unobtrusive in character.

The richest possible harmony of color consistent with the function of the hand bag is that produced by using two tones analogous to the structural color of the bag, one slightly warmer and the other slightly cooler than that color, and then by introducing into this combination two or three closely related tones of contrasting hues. For example, if the bag be of tan-colored material the principal areas of the design might be in a more reddish tan and a more yellowish tan. Small brilliant dots of blue-green, blue, and purple-blue added to this combination would give it richness and brilliancy without making the whole obtrusive.

The secret in any good combination of color is a combination which strikes the eye as a whole. Any element of form or color in a design which thrusts itself upon the attention of the observer is a blemish. Each should play its part unobtrusively in the making up of the total effect. Needless to add that total effect should have a dominant hue of its own, appropriate to the object. In the case of these satchels that hue might well be the natural color of the structural material. The colored burlaps may well be considered in this connection. These are commonly sold in shades of the colors in ordinary use, in tones of low intensity which offer delightful suggestions to the color student.

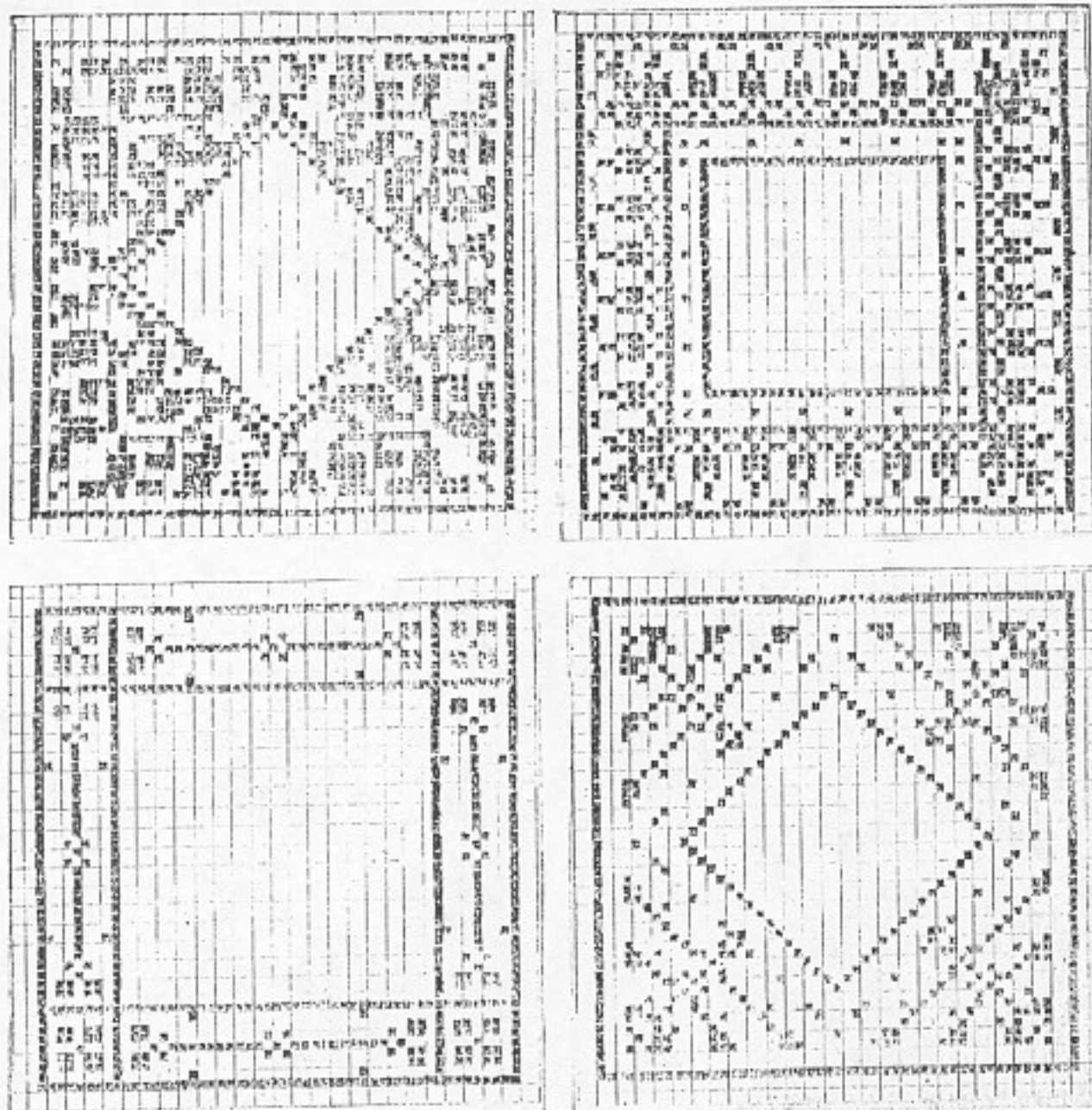
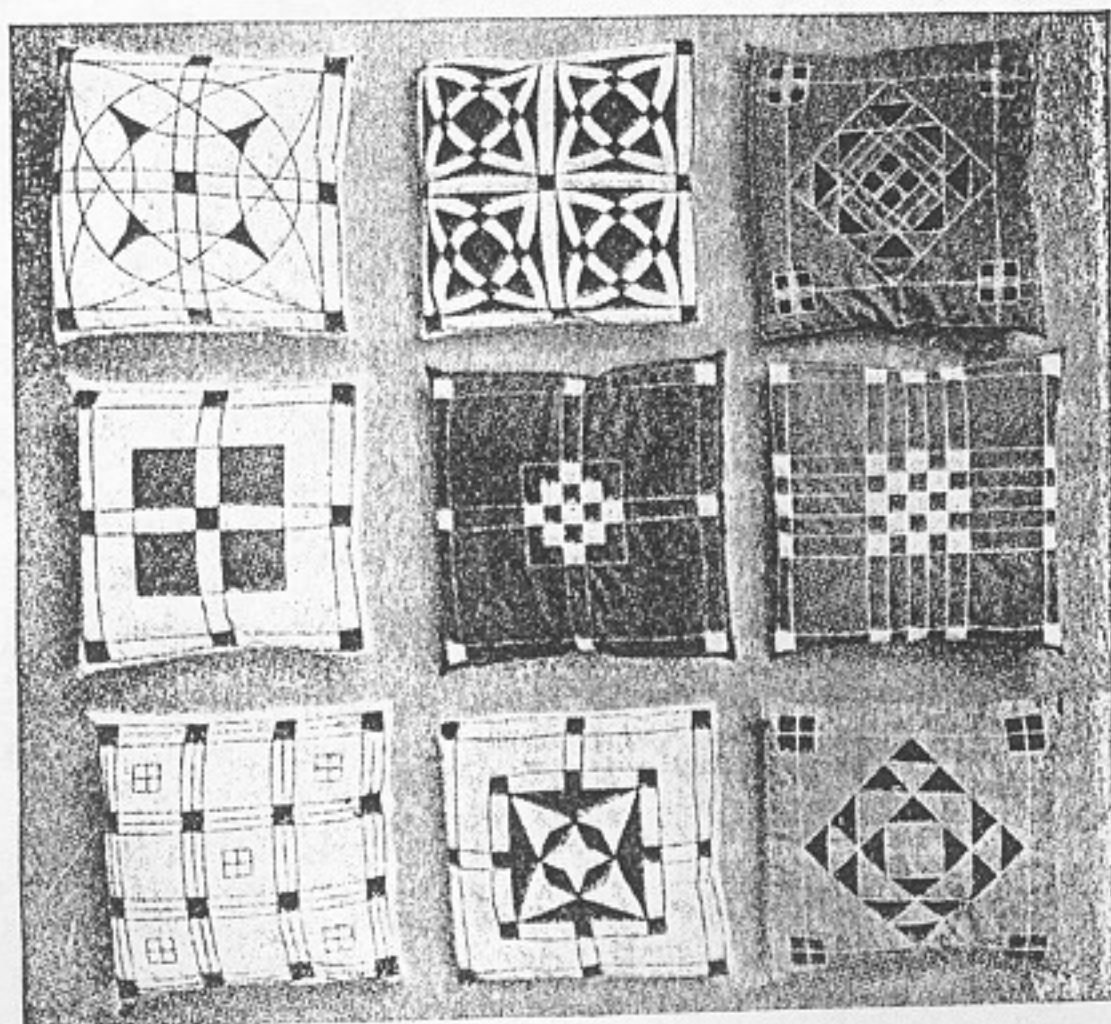
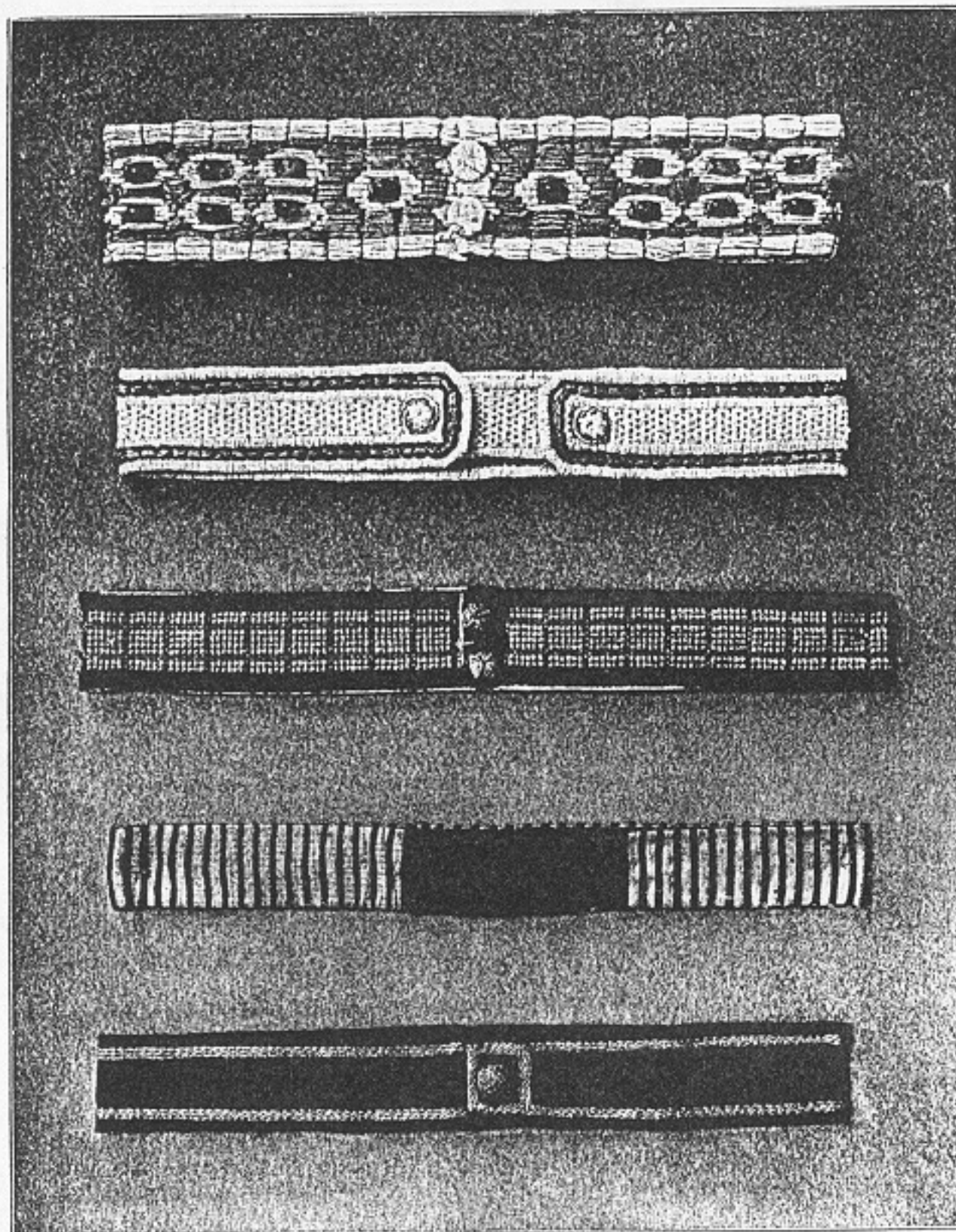


TABLE MATS stamped with a square peg. Here the pattern for a cross-stitch design was produced by hand printing, the pegtype being dipped in the color and applied to the squared paper. To produce these a square of manila paper was cut 9" on a side, and within this another square was drawn 8" on a side. One-half inch all round was left to allow for the hem in the finished work. The center is found by drawing the diagonals of the square, and in some cases the diameters. The inner squares were then planned upon these diameters or diagonals. The ornament is to be confined between the inner and outer squares, for an object is supposed to occupy the center of the mat, which is therefore left without ornament. The pattern may be in the form of borders, rosettes or surface patterns. An example of each kind

is shown in the illustration. The nine SOFA PILLOWS were planned and worked out by children in Germany, in the city of Darmstadt. They offer good motifs for designs that might be executed in any one of several materials. They might be stenciled upon buckram, binders' linen, burlap (for rough use) or leather. They might be done in applied work; that in the lower left-hand corner offers a charming surface and form for outline stitch. The designs of the upper left and lower right are of the order of the best in American patchwork quilts. They are all charmingly simple, based upon the circle and square. The art of printing upon wood after the fashion of the table mats

is the oldest form of printing known, the Chinese having discovered it centuries ago.

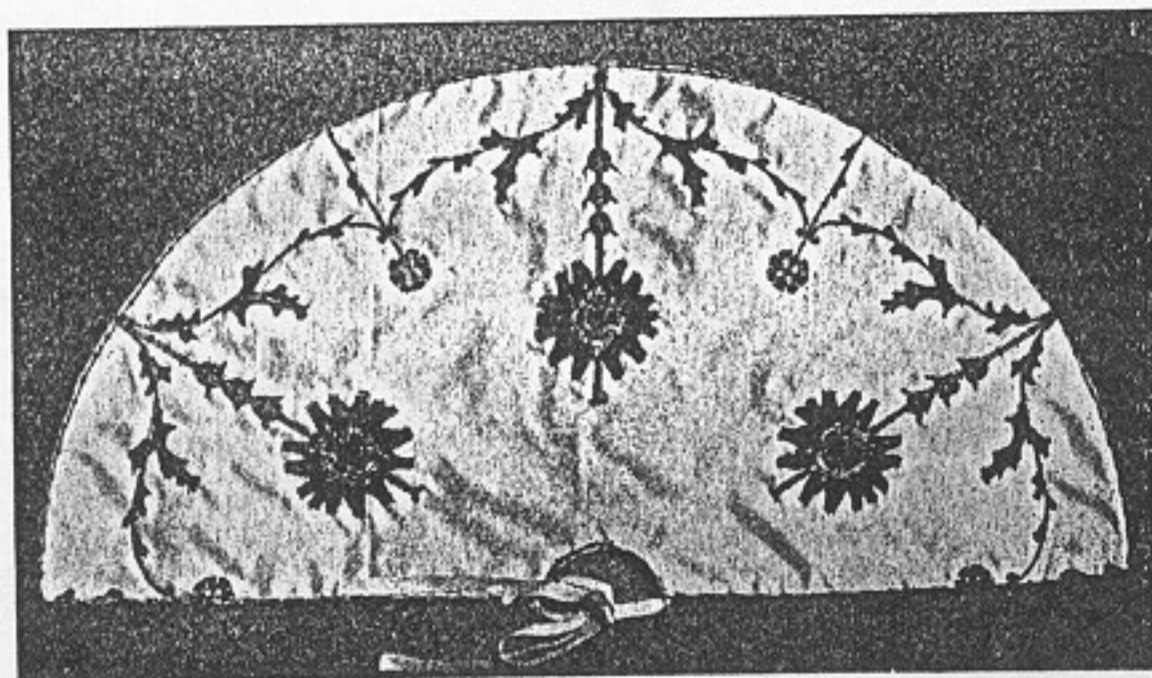




embroidery are to be seen, and in one piece have been introduced to give accents of color. The lower plate on the page shows a covering for an IVORY FAN, made merely for the purpose of protection, but enriched to suggest the value of that which it contains. This is an example of solid embroidery in various colors. It is an example, also, of the linking together of the parts of a design to form an effective whole. The work shown on pages 178 and 181 is fairly representative of fine German needlework in articles of clothing. The illustration on the lower part of page 178 shows the application of needlework in rather complex schemes of coloring to the cloth covers of gift books, or of books of special value highly prized by their owners. Nothing is too good for a priceless book. The plate shows also two designs for table mats made over circular cardboard or fiber of some kind. In work

In recent years the Germans have been producing fine needlework, not only in their manufacturing and in many a home, but in the public schools throughout the empire and in special schools of applied design. On this page are shown five examples of fine needlework of various kinds for BELTS. In all but one of these designs the theory of belt design is well exemplified; namely, that inasmuch as a plate is supposed to hold together securely whatever is inside it, the dominant lines in the design should be horizontal, suggesting bands or cords. In these designs, various kinds of

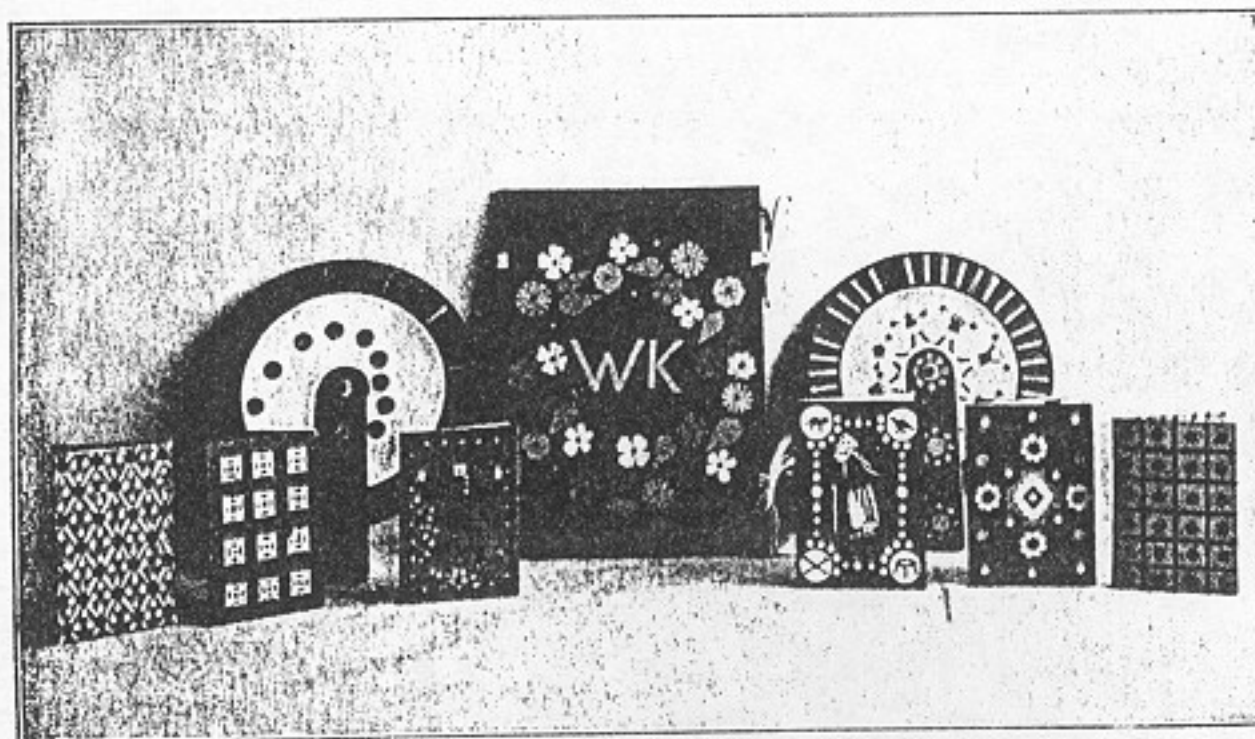
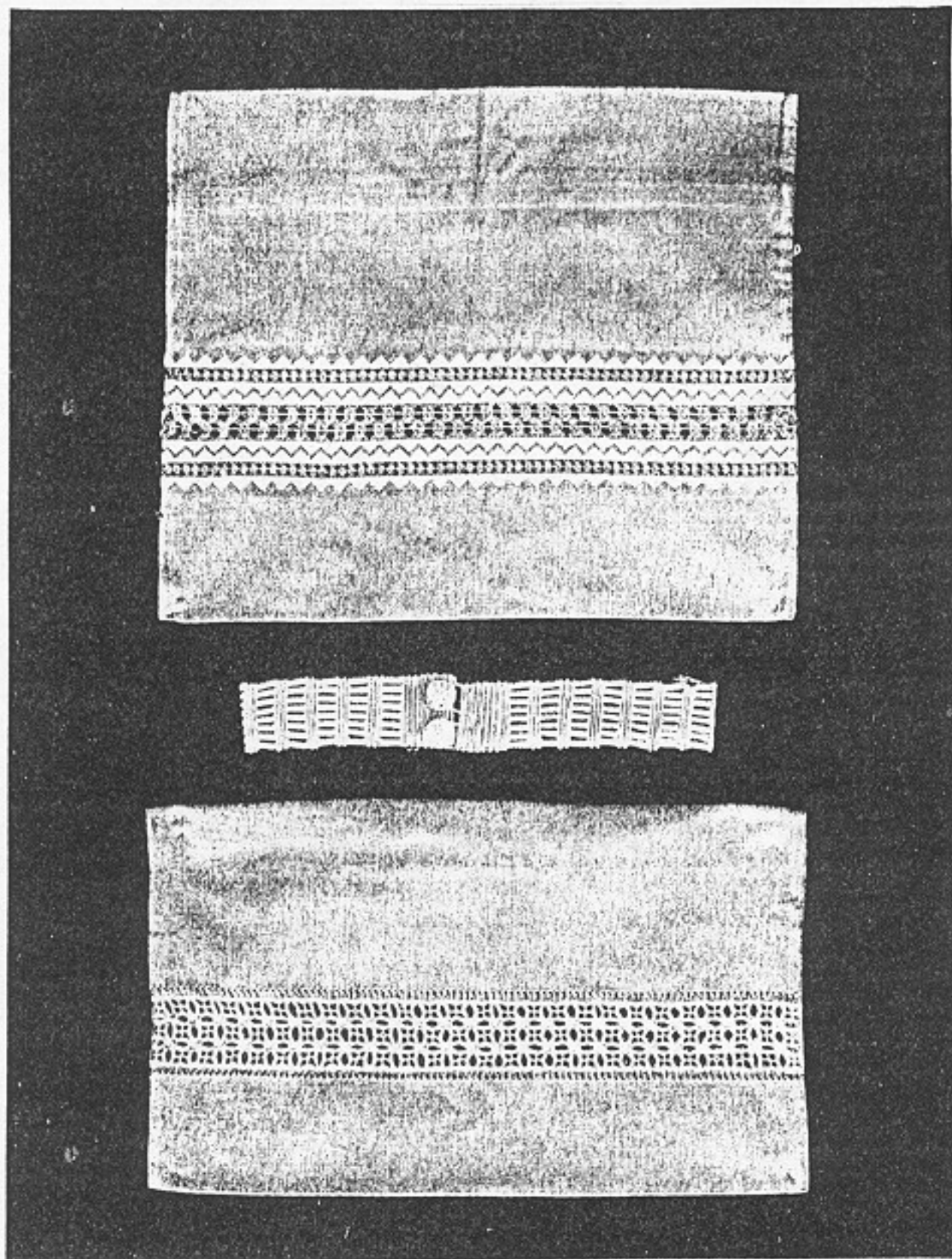
of this kind the embroidery is of course applied upon the cloth before the cloth is applied to



the board. After the decorated cloth is held securely in place by basting on the inside, a piece of plain cloth, hemmed to exactly the right size, is then sewed in all round to obscure the back of the piece and to give it a satisfactory finish.

The articles of apparel, shown on pages 179, 180 and 181, show a simplicity of design, a temperate use of ornament, and a skill in needlework heartily welcome to cultivated eyes, wearied with the cheaply-made, over-decorated goods which flood our department stores.

A little appropriate ornament — ornament having a character determined by the material and the processes appropriate to it, ornament well placed with reference to the object as a whole and its uses — gives perpetual satisfaction not only to the person who produced it, but to all who have seeing eyes. At an international congress of art teachers, held in London in 1908, the delegates were



given a reception at the South Kensington Museum, where some of the first families of England were represented in the receiving line. Among the delegates were two German drawing teachers with their wives. These women wore gowns designed by their husbands and made throughout by themselves. The gowns were perfectly related to the lines of the figure in each case; and, in color, to the complexion of the wearer.

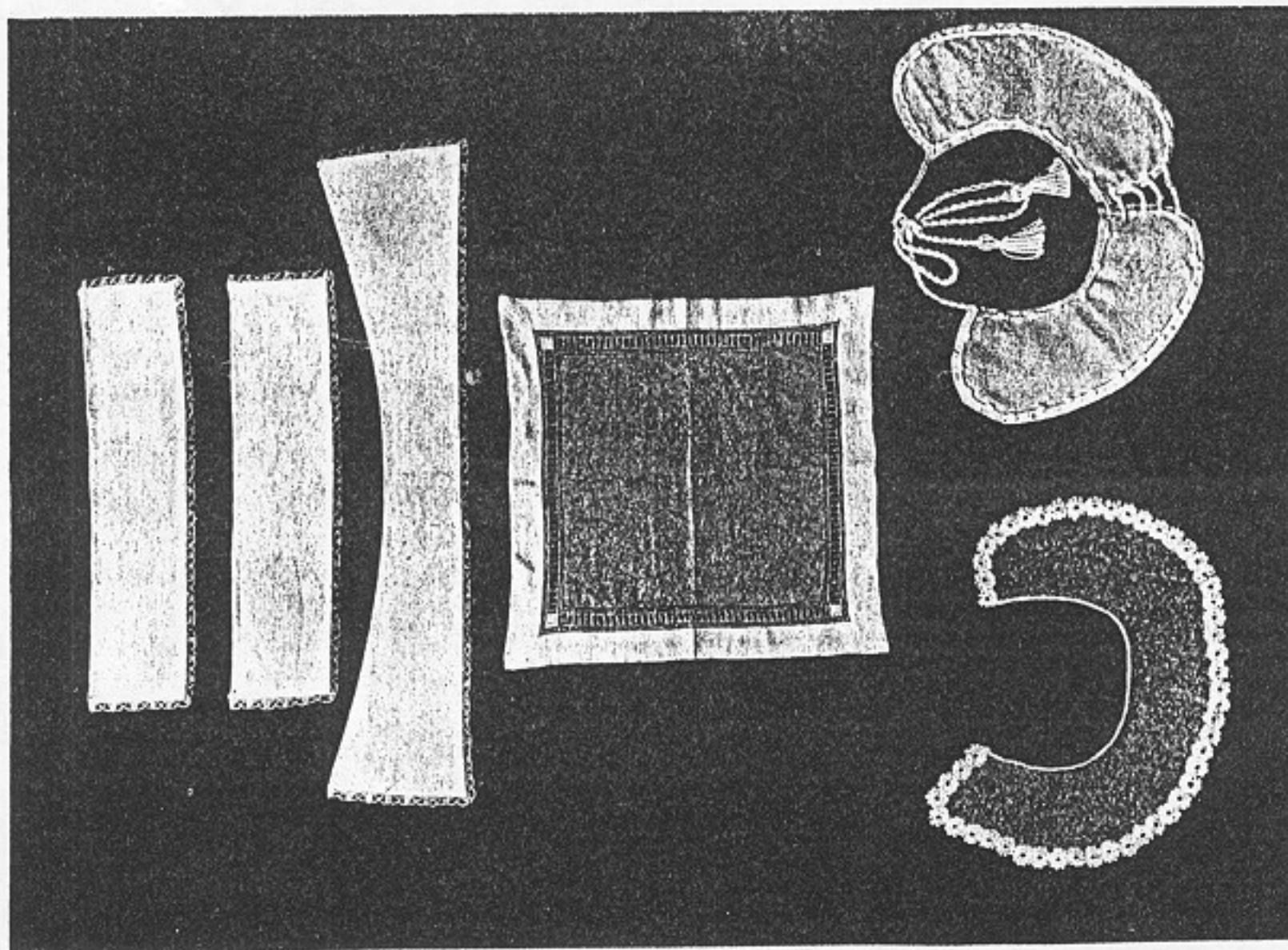
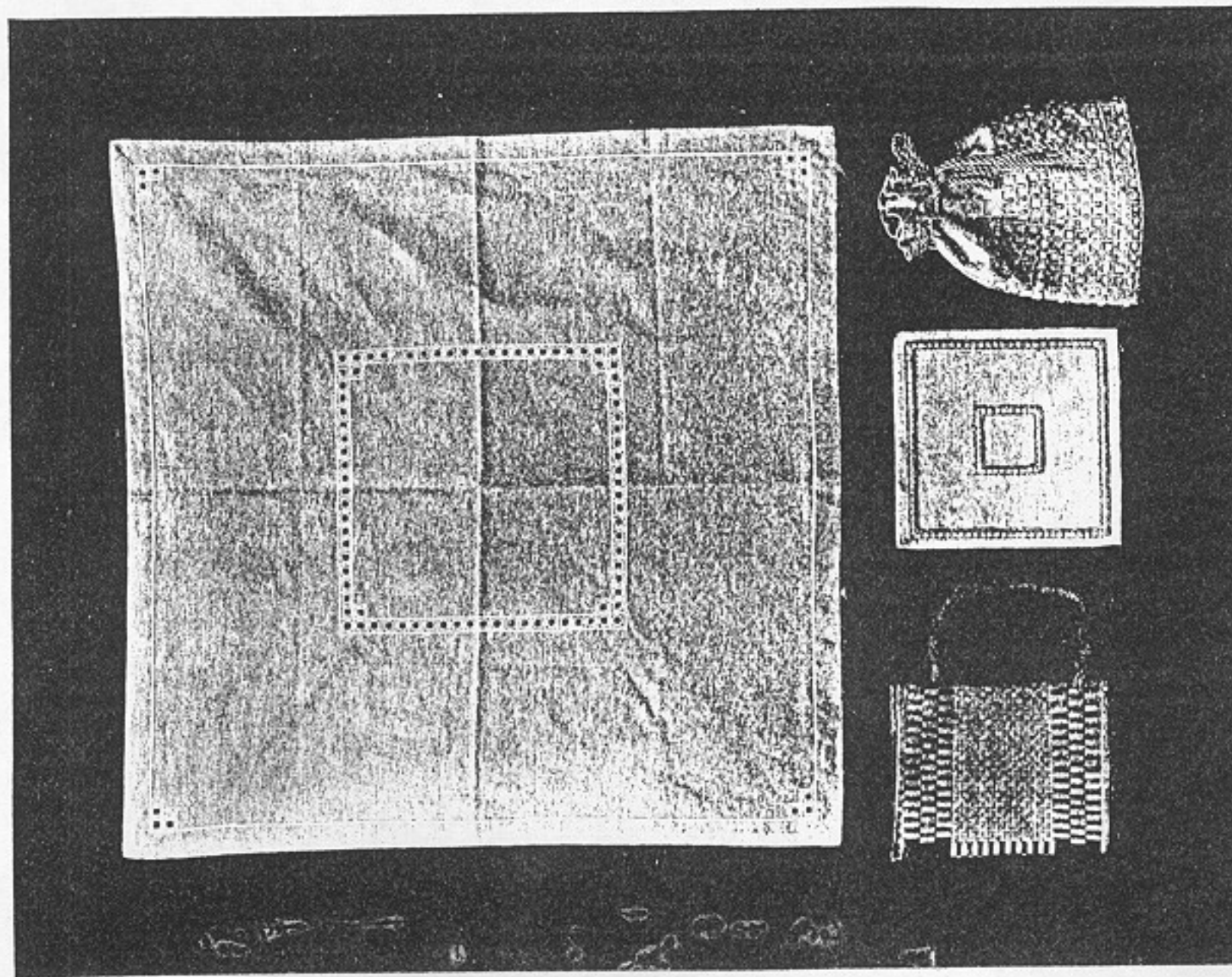
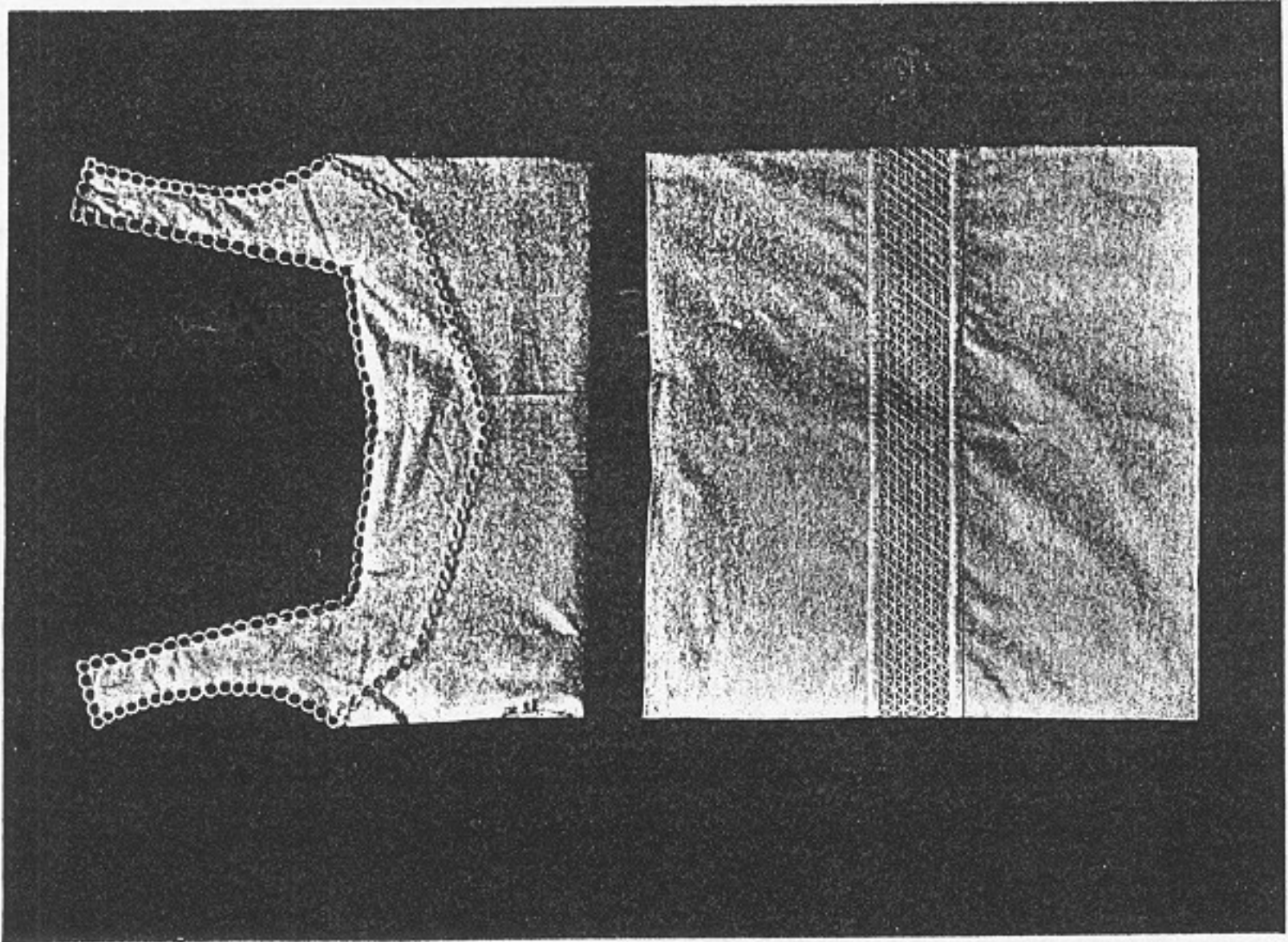
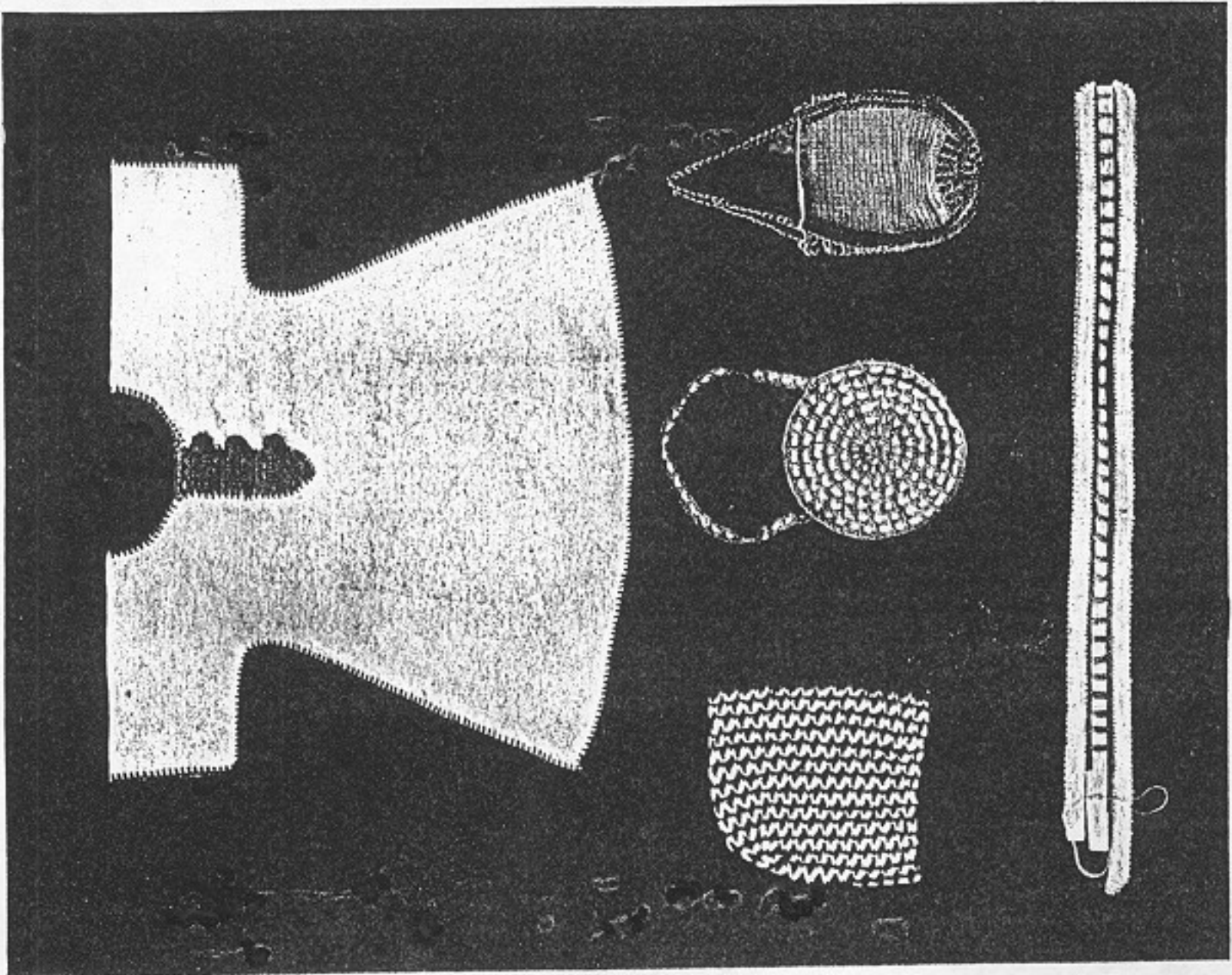
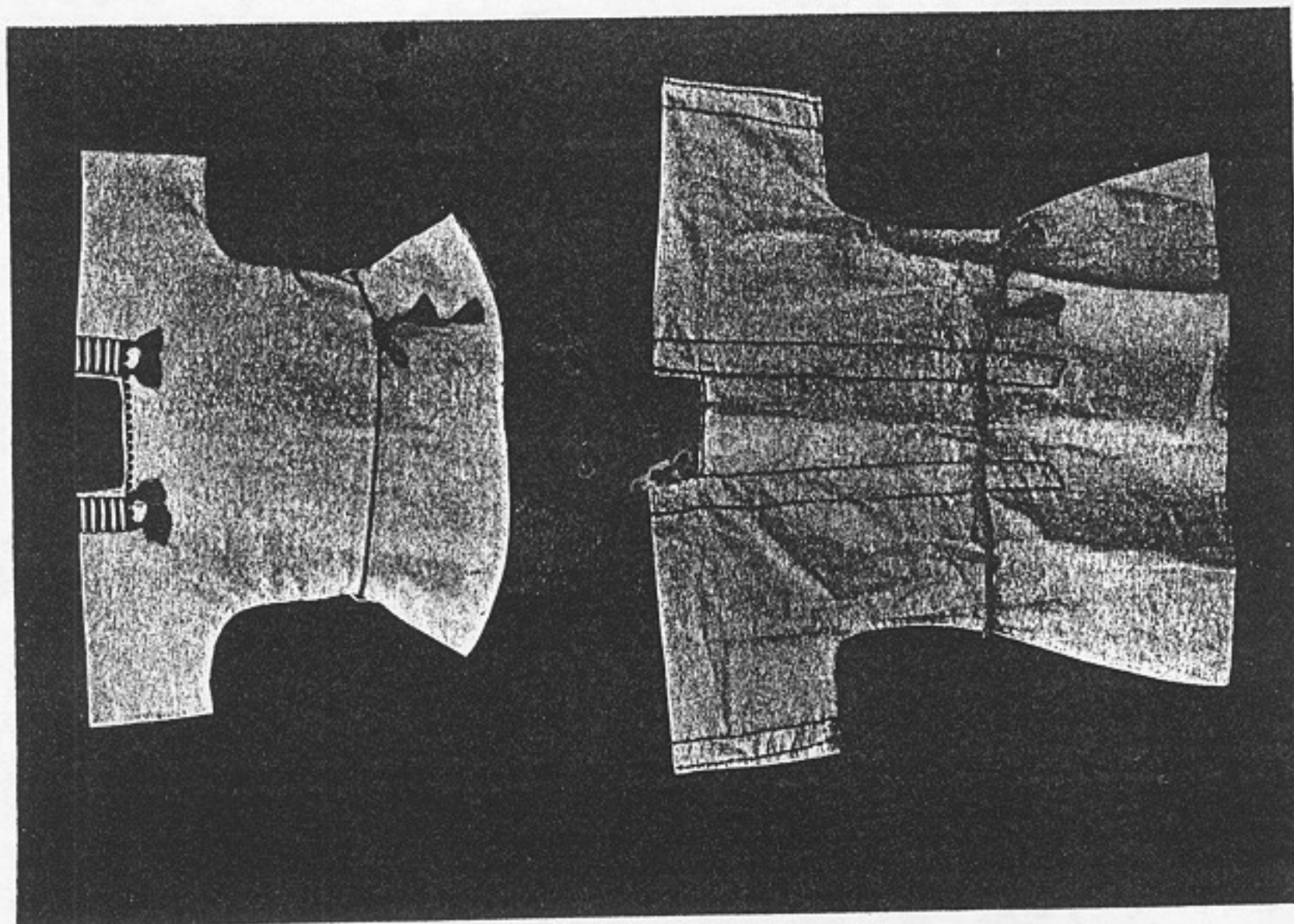


TABLE MATS, A DOILY, COLLARS AND CUFFS, AND HAND BAGS IN FINE NEEDLEWORK WITH CORDS, RIBBONS AND BEADS BY GERMAN STUDENTS

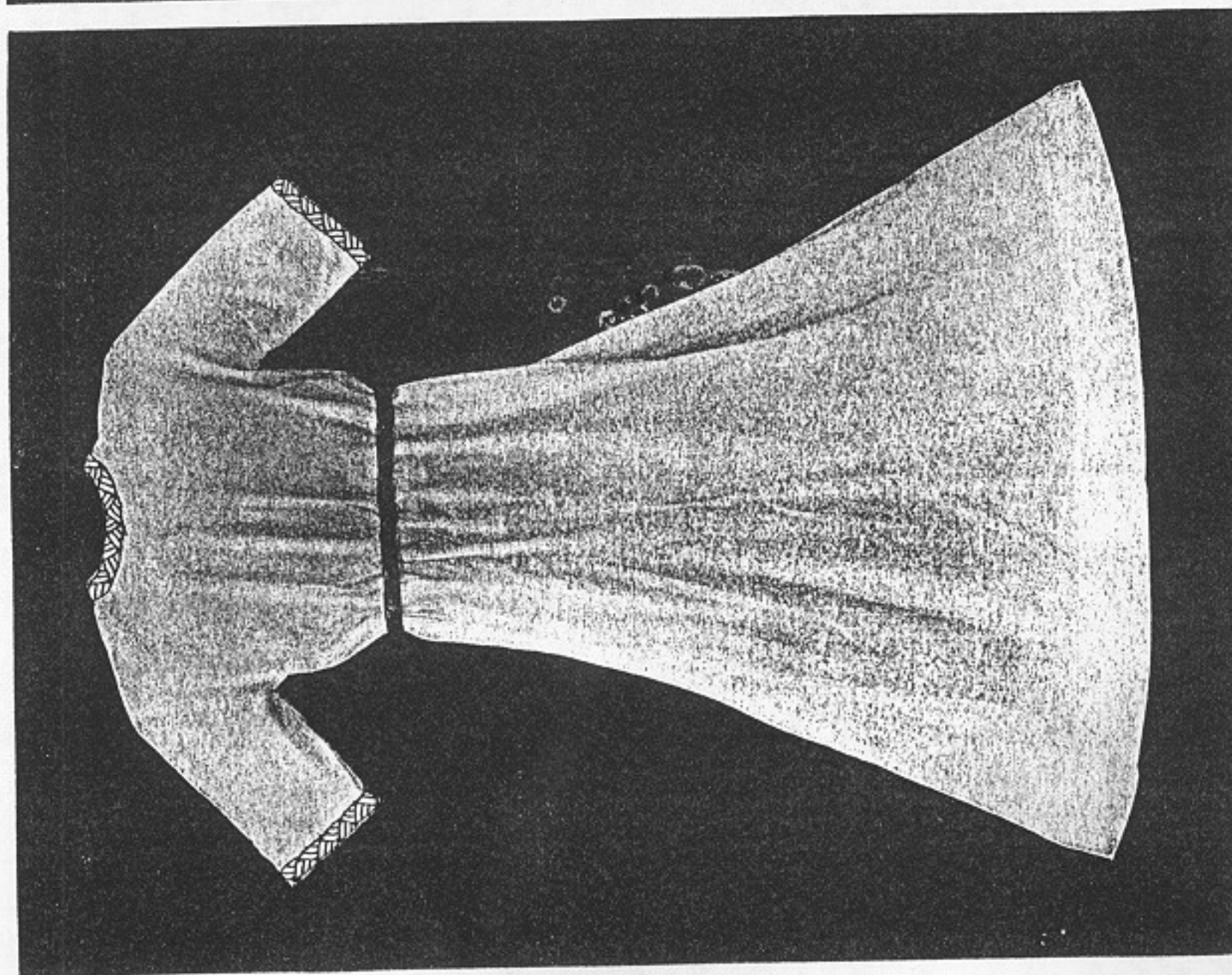
TASTEFULLY AND HARMONIOUSLY COMBINED

ARTICLES OF CLOTHING AND HAND BAGS SKILLFULLY WROUGHT BY GERMAN STUDENTS FROM COMMONPLACE MATERIALS





ARTICLES OF CLOTHING DESIGNED AND MADE BY GERMAN STUDENTS





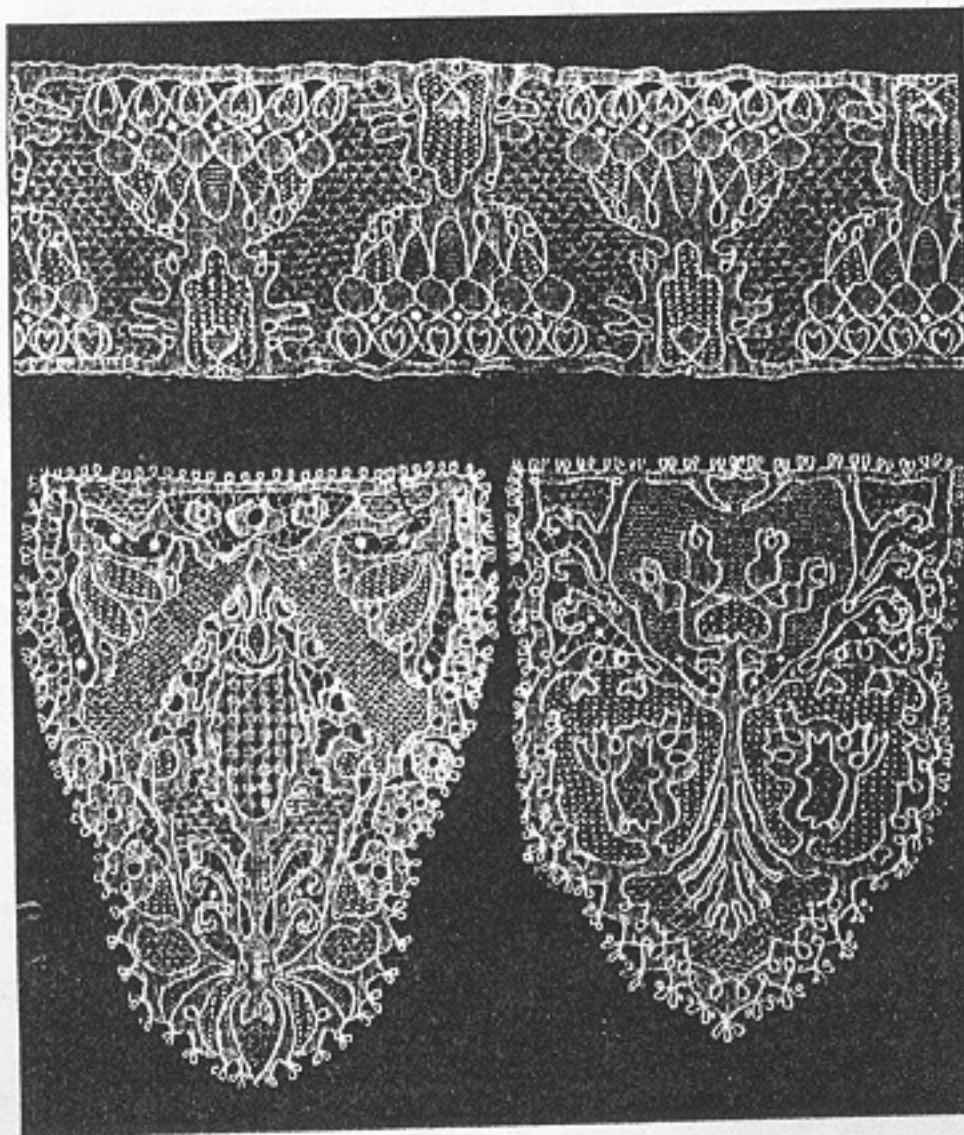
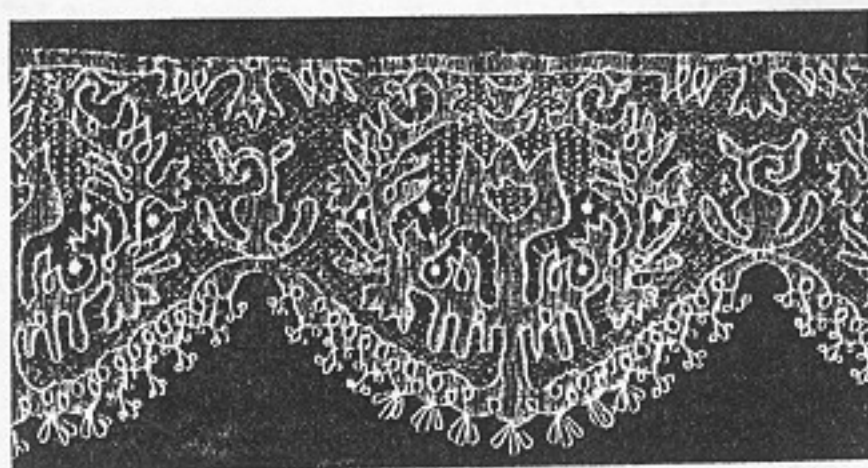
They were enriched with exquisite needlework, to the surprise of many an aristocratic Englishwoman. These two German women attracted more attention than duchesses. Machine-made finery, purchased ready-made, though loaded with jewels, looked tawdry and adventitious compared with the beautiful handicraft charged with personality and good taste.

The hood illustrated on this page shows heavy line stitch embroidery forming a conventional rose pattern of unusual character. Examples of lace, designed and wrought by German students, are also shown.

While these two patterns are far too complicated for the amateur to attempt, they are given here as a suggestion of what young people might do if they were properly taught in the schools or homes of our own country. One can learn the simpler forms of lace in a very few lessons, and thereby acquire the rudiments of one of the finest arts in the whole realm of needlework. A little practice in lace making gives one an insight into the craft, and opens the door to the keen enjoyment to be derived from the priceless treasures in lace to be found in our museums.

Well-trained teachers of lace making are, fortunately, beginning to appear in the United States, and the lace-making industries are being revived, notably in Minnesota. Certainly it is better to spend one's time in producing useful and beautiful things for the enjoyment of one's self and one's friends than to waste it in frivolous amusement.

Lace work is not difficult. The simpler forms require a comparatively inexpensive outfit, and the processes may be learned from a good teacher in one or two lessons of an hour each. Having mastered the elements of the craft, progress is easy. The results are so beautiful they become positively fascinating. A few moments a day will soon yield enough lace to enrich a gown.





HOUSEHOLD ARTS

COOKING FOR LITTLE GIRLS

ALMOST all little girls have sometime known the joy of keeping house on a wide, mossy ledge, with bits of blue and white china arranged in shining rows along the cracks which make the shelves; and wonderful mud pies, frosted with yarrow blossoms, stored away in safe corners of the stone pantry. Another pleasure, too, is in shaping thimble cookies and doll biscuit out of the dough which Mother or Norah has made and in baking these beside the big ones on the tin sheet. Best of all, at last comes the day for making something real, something which is truly a part of the family meal, or even, after a good deal of practice, the preparation of the whole meal itself.

Before a little girl starts to cook anything, she should be ready with a large convenient apron, to protect her dress from spots and flour. A white apron is best because it can be washed as often as may be necessary and yet it will not fade. It does not really soil any more quickly than a pink or blue one and it always looks fresh and dainty. It must not be very close fitting or it will be too warm. If the little girl wears short sleeves, she will need no sleeves in her apron, but if her arms are covered to the wrist she must have a sleeved apron or separate sleeves to slide on and protect her cuffs. Besides the apron, she should have a round holder, not too stiff, and a plain, hemmed dish towel. These may both be buttoned to the apron. The towel must never be used for a holder, while if the holder is not at hand, burned fingers may be the result. A cap may be worn, or the hair may be put back very straight and smooth while the cooking goes on. Of course, every little girl knows that her hands and finger nails must be entirely clean and dainty.

After she is personally ready for her work, she begins to make the acquaintance of her tools. She may not be introduced, as "Alice in Wonderland" met the "Pudding," but she must become familiar with such necessary utensils as measuring cups and spoons, quart measures, double boilers, saucepans, and many other useful utensils. She needs at least one real measuring cup which is made to hold just one quarter of a quart. This cup should be marked into thirds and quarters, to help the little cook in measuring for her dishes. Recipes are made to be prepared by measuring cups and spoons, and it would be just as unwise and harmful to buy ribbon or lace by "guessing at" the yard length or measuring with an umbrella or stray stick instead of a yardstick, as it is to "guess at" amounts of sugar, flour or milk, or to measure these in cups of uncertain size. Before the little cook begins to measure, here are some rules for her to remember, as well as a table of the measures commonly used in cooking:

TABLE OF MEASURES

1 saltspoon	= $\frac{1}{4}$ teaspoon
3 teaspoons	= 1 tablespoon
16 tablespoons	= 1 cup
2 cups	= 1 pint
2 pints	= 1 quart

GENERAL RULES FOR MEASURING

1. Fill the cup or spoon lightly, to the brim, then push off the extra material with a knife, having the edge of the knife against the top of the cup or the sides of the bowl of the spoon.
2. Never shake anything down in measuring it, as this gives too large a quantity. Do not in any way pack material into a cup.
3. Be dainty and careful not to spill as you measure. This helps to keep from wasting

material and also makes less trouble, besides keeping your worktable in neat order.

4. The teaspoonful and tablespoonful are always measured level.

5. Divide the spoonful into halves by making



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BOYS LIKE COOKING TOO

a straight mark from the handle to the point of the bowl and pushing out the material on one side. Cut this in half to measure a quarter.

"FIRST THINGS FIRST"

BOILING WATER

AFTER you have put on your dainty apron and examined your tools and tried a little measuring, you will wish to "cook" something. Cooking means the preparation of food

by means of heat, so some day you must learn how to build and manage a fire in the range, or to use the gas or electric stove. Just at first, we will suppose the fire is ready. Many things are cooked by receiving heat through boiling water, so you must know how to distinguish the appearance of water that is really boiling. Fill a saucepan about half full of cold water and put it on to heat, then notice the things that happen in it. Bubbles form on the bottom and sides of the saucepan, growing gradually larger and running together to form larger bubbles. These gradually leave the sides of the saucepan and dance about in the water. After a while they come to the surface, and at last one comes and breaks there, sending out a puff of steam. Then we say the water is beginning to boil. If we let the water boil for some time it will all disappear, going away into the air in the form of steam, leaving the saucepan dry. If the water evaporates too much while you are cooking something in it, your saucepan will be spoiled and your food will burn in it. If you watch some cocoa shells as they are cooking in the boiling water you may see how the currents of heat carry them from the bottom to the top.

COCOA SHELLS

$\frac{1}{2}$ cup of cocoa shells

3 cups of water

Let the shells boil in the water for an hour, adding more water as the first boils away, to keep the original quantity. Strain out the shells and serve the shells with sugar and scalded milk.

SCALDING MILK

You will constantly need to use scalded milk, and there is but one way to prepare it, though you may use many kinds of utensils. Scalded milk is cooked over hot or boiling water and not over the direct heat. You must have, then, some sort of a double boiler, so that there is a chance for water in the lower pan and for the milk in the upper one. It is not necessary to have a double boiler from the store, for two saucepans of different size, a pail and a saucepan or any other good combination, will do as well. While the milk is heating, watch it, and notice

the "wrinkled skin" as it forms over the top. This is the sign that the milk is scalded.

REASONS FOR BOILING WATER

1. To cook other things in it.
2. To make it more wholesome and pure in case it contains any harmful dust plants.
3. To soften it if it is hard.

REASONS FOR SCALDING MILK

1. To cook other things in it.
2. To make it more wholesome by killing any harmful dust plants that might be in it.
3. To make it keep sweet longer.

SOME DISHES TO MAKE WITH POTATOES

POTATOES are nowadays so common and usually so cheap that it seems strange to remember that they were unknown to civilized people until English colonists found them in Virginia and carried some back to England. They are enlarged portions of underground stem, and not roots, as carrots and turnips are. Potatoes may be cooked with or without their jackets, according to the use you wish to make of them and the age of the potato. If they are pared, remove a thin paring only, because the best part of the potato lies directly under the skin.

BAKED POTATOES

Choose medium-sized potatoes and wash them thoroughly. Lay them in a pan on the rack in a fairly hot oven and let them cook until they are soft all over. If you turn them occasionally they will bake more evenly. Bake about thirty-five minutes. Serve hot, in a napkin.

BOILED POTATOES

Choose medium-sized potatoes and scrub them. Pare them, unless they are very new. After they are pared put them at once into freshly boiling, salted water, enough to cover

them. (Use one tablespoonful of salt to one quart of water, for six potatoes.) Let them boil until they are tender when tried with a fork. (About twenty-five minutes.) Drain off every drop of water and let them stand, uncovered, in a warm place to drive off the steam. Serve hot with meat or fish gravy. Or make them into

RICED POTATO

Press hot boiled potato through a potato ricer or coarse strainer. Pile lightly on a dish and serve very hot. Make this into

MASHED POTATO

Measure the hot riced potato, and for every cup of potato add one tablespoonful of butter, one-fourth teaspoonful of salt, and a very little pepper. Put these with the potato in a sauce-



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A FIRST LESSON

pan and add enough hot milk to make it light and creamy but not too moist. About one and one half tablespoonfuls for one cup is usually

enough. Beat the whole with a fork, while you reheat it. It should be light and white when it is done. Pile lightly on a hot dish and serve hot.

CREAMED POTATO

2 cups of boiled potatoes, cut into dice (small cubes)
 $\frac{1}{2}$ teaspoonful of salt
 A very little pepper
 $\frac{1}{3}$ cup of milk
 1 teaspoonful of chopped onion, if you like

Cut the potatoes into dice and add to them the salt and pepper. Cook the onion in the milk until the onion begins to be tender. Add the potato and cook until the milk is mostly taken up. Stir in the butter and serve hot. It may be trimmed with parsley which has been thoroughly washed and dried.

FRIED POTATO

2 cups boiled potatoes, cut into dice
 $\frac{1}{2}$ teaspoonful of salt
 A little pepper
 1 tablespoonful of butter or beef dripping
 1 tablespoonful of chopped onion

Cut the potatoes into dice and sprinkle them with the salt and pepper. Cook the onion in the fat (butter or dripping) until it is a light brown; then add the potatoes and cook until they have taken up the fat and are brown. Serve hot, garnished with parsley.

EGGS

EGGs are so useful and so nourishing, yet sometimes so expensive, that you must learn to cook them very carefully to obtain the best results. Nothing should be wasted, but it is worse to be careless with gold pieces than with pennies, and eggs and butter stand for gold pieces among our common food materials.

Eggs contain a substance which cooks with very little heat and becomes tough and indigestible when cooked too long or at too high a temperature. To see this substance you may prepare a dropped egg. This would be a good dish, if you learned to make it well, to arrange for Mother when she had a headache and you prepared her luncheon or breakfast.

DROPPED EGG

Wash the egg carefully and break it into a cup, taking great pains not to break the yolk. Butter a smooth, clean frying-pan and put into it one cup of water and one-fourth teaspoon of salt. (If you have a buttered muffin ring in the water, to hold the egg in a round shape, it will be easier.) Let the water just come to the boiling point, then gently pour the egg into the muffin ring and at once lower the heat to keep the water just below boiling. Pour the water over the egg, to form a little veil of cooked white of egg over the surface of the yolk. (Notice how the white of eggs turns white and jellylike as it cooks, and notice also that it cooks while the water is not boiling.) When the egg is firm and jellylike, but not tough, remove it from the water with a skimmer and place it on a piece of buttered toast. Serve hot.

You will understand why we do not really *boil* eggs when we cook them in their shells. They cook more evenly and with less danger of being tough, if they are cooked just below the boiling point. Of course the egg must be cooked a longer time than would be necessary if it were boiled.

EGG COOKED IN WATER

"SOFT-BOILED"

Put the egg into water just below the boiling point and let it stay six or eight minutes. Be sure that there is water enough to cover the egg all over. Notice the little bubbles on the surface of the egg and on the bottom and sides of the saucepan and remember that these show that the water is very near to boiling, but that so long as they do not go to the surface and break there, actual boiling is not taking place.

"HARD-BOILED"

Cook the egg as in the last recipe, but let it remain in the water thirty minutes. At the end of this time the white should be firm but not tough and the yolk dry and powdery.



TWO COOKING CLASSES IN GRADE SCHOOLS

Above, the girls are working with gas stoves; below, they are preparing materials for the lesson.

These eggs are suitable for picnic lunches and for garnishing of all sorts.

SOFT CUSTARD

1 whole egg or the yolks of 2	Speck of salt
2 tablespoonfuls of sugar	1 cup of milk
1/4 teaspoonful of vanilla	

Scald the milk. Beat the egg slightly, with a fork. Add to it the sugar and salt. Pour the scalded milk over the egg, etc., and put the mixture back into the double boiler. Let it cook with constant stirring, until it is thickened and creamy. (Do not let the water boil under it.) Remove from the boiler, strain, and add the vanilla. If it curdles, beat it with an egg-beater until the lumps break up and it is smooth. But with care about the heat it will not curdle. The yolks of eggs make a smoother custard than the whole egg. Make a frosting by beating the white very stiff and dry and adding to it one tablespoonful of powdered sugar for each white of egg. Put this on the custard after it is cool and you have Floating Island.

CREAMY EGG

2 eggs	1/2 cup of milk
1/2 teaspoonful of salt	2 teaspoonfuls of butter
Speck of pepper	2 slices of toast

Scald the milk. Beat the eggs slightly with a fork and add to them the salt and pepper. Pour over them the scalded milk and return the whole to the double boiler. Cook as in the recipe for Soft Custard. Add the butter after the egg is removed from the heat and beat it in thoroughly. Serve hot on the toast.

OMELET

1 egg	Speck of pepper
1/4 teaspoonful of salt	1 tablespoonful of milk
1 teaspoonful of butter	

Separate the white and yolk of the egg and beat the white very stiff and dry and the yolk until it is light colored and creamy. Add the salt and pepper to the yolk. Melt the butter in a smooth frying-pan, and when it is bubbling, but not brown, add the milk to the yolk of the egg and cut into it the stiff white.

Pour it at once into the buttered pan and cook gently, lifting it now and then at the sides. When it is golden brown turn it in the pan, or put it into the oven to cook the top. Make a gash on opposite sides, fold together, and turn the omelet out on a hot platter. The omelet must not cook too fast nor too long, or it will burn or be tough.

THE CARE OF EGGS

When eggs are brought into the house they should be washed carefully and wiped dry. The shells, when broken, may then be saved to use in clearing coffee. Eggs should be kept in a cool, dry place.

TEST FOR THE FRESHNESS OF EGGS

If an egg is placed in water enough to cover it entirely you can see how fresh it is by noticing the position it takes. If it lies quietly on its side, on the bottom of the pan, like a stone, it is very fresh. If it stands up on the pointed end, but without floating, it is still in good condition. If, however, it floats in the water it is to be regarded with doubt and is probably not good for use.

HOW TO MAKE WHITE SAUCE

WHITE Sauce is one of the most useful things to understand, because if you know how to make it well you can use it in a great many ways, by flavoring or seasoning it differently. It may be prepared as a sauce for vegetables, toast, fish, or egg, or by using meat stock in place of the milk it may be made into gravy. If it is sweetened and flavored with vanilla or fruit juice it becomes pudding sauce. "Cream soups" are made like white sauce, only that they are thinner and are flavored with the vegetable which gives each its name.

WHITE SAUCE

2 tablespoonfuls of butter	Speck of pepper
2 tablespoonfuls of flour	1 cup of milk
1/4 teaspoonful of salt	

There are two methods of mixing this sauce. The first is easier for a beginner, but the sauce is not so digestible.

Method 1. Scald the milk. Melt the butter, but do not let it brown at all. (It needs very little heat to melt butter.) Mix together the flour, salt and pepper, and stir them into the melted butter until a smooth paste is formed. Add the milk to the paste of butter and flour, adding one-third of it at a time and letting the sauce boil and thicken each time before adding more milk. Stir it constantly. Cook until it is thick and free from the taste of raw flour. Strain and serve with vegetables or on toast, if the pepper is left out.

Method 2. Scald the milk, all but two tablespoonfuls. Mix these with the flour, salt and pepper until a smooth paste is formed, then go on adding the milk as in Method 1. When the sauce is free from all floury taste, stir in the butter, remove from the heat, strain, and serve.

"EGG GOLDENROD"

1 cup of white sauce	6 slices of toast
2 or 3 hard-cooked eggs	Parsley

Prepare the white sauce and cook the eggs hard, as you have already learned to do. Remove the shell and skin carefully and separate the white and yolk. Chop the white into small pieces and stir it into the white sauce. Pour this over the toast. Press the yolk through a coarse strainer, with a wooden spoon, and sprinkle this yellow powder over the white sauce on the toast. Trim the dish daintily with sprigs of clean dry parsley, if you have it.

HOW TO USE PARSLEY

1. Wash the parsley carefully and dry it gently with a clean cloth.
2. Use only good parsley and not too much. Stick the stems down, so that only the leaves show as the dish is served.

BISCUIT

SOMETIMES you wish some kind of bread very quickly, and yeast bread takes a long

time to prepare, but baking-powder biscuits are easily made in a very short time. In some ways, too, they are more wholesome than yeast bread.

BAKING-POWDER BISCUIT

1½ cups of flour	½ teaspoonful of salt
2 teaspoonfuls of baking powder	1½ tablespoonfuls of butter
¾ cup of milk or milk and water	

1. Sift together the dry ingredients.
2. Cut in the butter with a knife.
3. When the butter is so small that you cannot see it, cut in the liquid until a smooth dough is formed.
4. Place the dough on a floured board and roll, very lightly, until it is about three-fourths of an inch thick. Cut out with a biscuit cutter and bake on a buttered tin or tin sheet in a hot oven, for twelve or fifteen minutes.

SHORTCAKE, INDIVIDUAL

1½ cups of flour	½ teaspoonful of salt
2 teaspoonfuls of baking powder	3 tablespoonfuls of butter
	¾ cup of milk
2 teaspoonfuls of sugar	

Mix like the biscuit, adding the sugar with the salt and flour. After the dough is cut out, lay the little circles in pairs, buttering the lower ones a little, then bake. After they are done, they will split easily where they were buttered; then fill them with crushed and sweetened fruit, which may be put in the middle and also on top. Stewed dried apricots make a delicious filling for the shortcakes when there are no fresh fruits.

Caution

1. Do not handle the dough at all with the fingers, as that makes it tough.
2. Use as little flour as possible, and make the dough as soft as you can.

SOME SIMPLE CANDY

HOME-MADE candy is better than much candy that you buy, because you know that it is made of good materials. It also costs less, and is simpler and less indigestible. The proper time to eat candy is after dinner or some

heartly meal, when you are not hungry and are not likely to eat more than is good for you.

Sugar, when it is cooked either by itself or in boiling water, is extremely hot, so you must be very careful not to burn your fingers in stirring it. The first candy you can make by heating the sugar all by itself.

PEANUT BRITTLE

1 cup of sugar $\frac{3}{4}$ cup of chopped nuts

Put the sugar into a smooth, clean frying-pan and let it melt until it is a light golden brown sirup. Stir it constantly while it is melting. When there are no grains of sugar left, stir in the chopped nuts and pour the candy at once on a tin sheet. Score it while it is cooling, so that after it is cold it will break into square pieces. Scoring candy means marking it deeply on the surface, without trying to cut it through. You must often *begin* to score when the candy will not hold the mark permanently, or else you cannot score it at all at the end. If the mark disappears, go over it again as you did at first.

MOLASSES PUFF

1 cup of molasses $\frac{1}{4}$ teaspoonful of soda

Butter a saucepan and cook the molasses in it until, when a little of it is dropped into cold water, it is perfectly brittle. Stir in the soda, remove from the heat, and pour it out on a buttered tin. Score, while cooling.

WHITE OF EGG CREAM CANDY

1 white of egg 1 tablespoonful of water
Flavoring Nuts, dates, etc.
Powdered sugar

Mix the white of egg, water, and flavoring, but do not beat them. Add powdered sugar enough to make a firm paste which can be handled. Make this into balls and lay a half nut on each side of each ball. Roll in granulated sugar. Or you may stuff washed, stoned dates, or candied cherries with the paste. The flavoring may be vanilla, lemon, or almond, as you like. You may also stir a little powdered

cocoa into the sugar, until you have the color and flavor you like. With this foundation you may make many simple but attractive kinds of candy, by using your ingenuity, in varying the flavor and the fruit or nut which you use with it.

If you have not time to make this candy, you will find that dates stuffed with peanuts or with English walnut meats or halves of almonds are delicious. Put in the nuts, press the dates back into shape, roll in powdered sugar, and serve as a confection.

FUDGE

2 cups of sugar $\frac{3}{4}$ cup of milk
1 tablespoonful of butter 2 squares of chocolate
 $\frac{1}{4}$ teaspoonful of vanilla

Melt chocolate in the saucepan, add sugar and milk. Cook until it strings from the spoon or if dropped in water forms a soft ball. Add butter and vanilla. Remove and beat five minutes. Much of the success of candy-making depends on beating. As you gain experience, you will be able to tell by the feeling and appearance just when to take it off to prevent its being either too soft to cut or too sugary. A tablespoonful of shredded cocoanut sifted in after fudge is removed from the stove takes from the extreme sweetness.

COOKING FOR OLDER GIRLS

OF all the arts that a girl can learn, cooking is the most useful and rewarding. Everyone must eat, and the person who can meet this need with appetizing, skillfully prepared dishes wins praise from every side. But cooking must be learned with patient trials and much experimenting. As little girls we do the simplest things, getting our experience of handling food and dishes; as older girls we learn more about the processes and principles of cooking, for if we understand how to do a few standard things well, we shall find we have the key that unlocks to us all the mysteries of our mothers' cookbooks.

Try these simple recipes until you can bring them to perfection. You will find you have become mistress of a womanly art that will be

a source of delight and a means to independence all your life. No woman is so helpless as the one who cannot prepare a simple meal.

BREAD

EVERY girl should know how to make bread, even in these days of good, well-managed bakeries. More and more bread making is being done outside the home, and when the conditions are satisfactory this may be a good thing; but every housewife should understand the process of manufacture and the principles which underlie it, so that she may have a standard and know what to demand in quality and care. Many people feel that the ability to make good bread is a test of a girl's skill in cooking, and certainly nothing is more satisfactory than to be able to prepare a wholesome, attractive loaf of bread or a sheet of light, golden brown biscuit. Bread making is not an especially difficult process, but care, patience, and the judgment which comes from experience are needed to make a successful bread maker.

Bread raised with yeast is really lightened by the life process of certain very tiny plants, called yeast plants, which we sow and cultivate in the dough as we set it. If we keep in mind the requirements of larger plants, so far at least as heat conditions are concerned, it will be easy to see why certain things must be always the same in bread making.

BREAD

2 cups of liquid (milk or water or part of each)
 1½ tablespoonfuls of butter
 1 tablespoonful of sugar
 2 teaspoonfuls of salt
 1 yeast cake in 3 tablespoonfuls of lukewarm water
 About 6 cups of flour

Scald the liquid, whether it be milk or water or a mixture of the two. (Milk makes a whiter, richer, and more nourishing bread, but bread made with water does not dry quite so quickly.) Pour the hot liquid over the butter, sugar, and salt, to melt and dissolve them. Soften the yeast in the lukewarm water. (Lukewarm water is water which feels neither hot nor cold to the finger.) Cool the milk, etc., until it is

lukewarm, then add to it the softened yeast. Add the flour, sifted and measured, cutting the last of it in with a knife. (All the flour may not be needed.) When the dough is stiff enough to knead, turn it out on a very clean, floured board and knead with very clean hands or cut with a knife until it is smooth and elastic, so that it springs back lightly when indented with the finger. Put it into a clean bowl, slightly buttered on the bottom, and set it in a warm (not hot) place, to rise. Keep it closely covered while it is rising. When it has doubled in size, put it again on the bread board and knead it until it has no large holes; then shape it in any desired form. Put it into the baking pans and let it rise as before, to twice its size. Then bake until it is a golden brown and does not stick when tried with a clean, fine knitting needle. It will take from forty-five to sixty minutes for a loaf of bread to bake.

Precautions

1. Be sure not to have too much heat at any point in the process of bread making, up to the time of baking. Too little heat makes the rising slow, but too much heat is ruinous.
2. Use as little flour as possible on the board. Too much flour makes the dough hard and tough. Mix the bread as soft as it can be handled.
3. Cover the dough well while it is rising, for three reasons: (a) To keep it at a uniform warmth, protected from drafts. (b) To keep it clean and protected from dust. (c) To keep a hard crust from forming over the top, caused by the evaporation from the surface.

CARE OF BREAD AFTER BAKING

Bread should be cooled at once and rapidly, in a draft of cool, clean air. After it is thoroughly cool it should be put into a clean, cool, dry place, covered well. Pieces of bread, left over, must never be allowed to become moldy in the bread box.

RULES FOR BAKING

(These rules apply not only to the baking of bread, but to baking in general.)

Divide the time allowed for baking into quarters.

First quarter. The articles should begin to rise.

Second quarter. The articles should finish rising and begin to brown.

Third quarter. The articles should finish browning.

Fourth quarter. The articles do not change in appearance, but cook through and shrink away from the sides of the pan.

CINNAMON ROLLS

Take ordinary bread dough, and after the first rising is finished, knead until it has no large holes, then roll it out in a sheet about one-half an inch thick. Spread this with butter that has been softened by creaming with a knife, but not melted. Sprinkle with a layer of sugar and cinnamon, mixed together. Use two tablespoonfuls of sugar to one-third of a teaspoonful of cinnamon. Chopped raisins may also be scattered over the cinnamon and sugar. Roll up the dough like a jelly-roll and cut into slices, about three-fourths of an inch thick. Lay the slices in a buttered pan, with the cut sides up. Let them rise to double their size and bake about twenty or twenty-five minutes.

SALADS

NO dish is more attractive than a daintily prepared salad, especially in the summer-time when heavy, hot dishes pall upon the appetite. Salads may be very nourishing and suitable for the main dish of a meal or merely an addition to it, according to the kind of salad.

Salads are made up of three parts: the green, fresh vegetable upon which they are arranged, the dressing, and the fish, meat, fruit, or vegetable which gives its name to the salad. Sometimes the dressing is used alone upon the green vegetable, as in dressed lettuce.

Lettuce, celery, parsley, cabbage, dandelion, and water cress are among the common kinds of green vegetables used for salad. They must be most carefully prepared and washed to make sure that they are entirely clean and free from all insect life. After washing they

must be carefully dried and chilled before arranging the salad upon them.

French dressing, boiled dressing, and mayonnaise are the most usual forms of salad dressing. They are used for different kinds of salads. Mayonnaise is the richest and most nourishing, on account of the egg and oil contained in it. It is not, however, an extravagant kind of dressing, because it is so rich in food material and the oil makes it particularly wholesome.

FRENCH DRESSING

1 teaspoonful of salt	$\frac{1}{4}$ teaspoonful of pepper
3 tablespoonfuls of vinegar	$\frac{1}{3}$ cup of olive oil

Mix the dry ingredients and add the vinegar. Stir the oil in, a little at a time, stirring well.

This form of dressing is used for dressed lettuce, dandelions, water cress, and for marinating salads of all kinds. It must be kept stirred during the time of serving, as it tends to separate on standing.

BOILED DRESSING

1 teaspoonful of salt	$1\frac{1}{2}$ teaspoonfuls of sugar
$\frac{1}{2}$ teaspoonful of mustard	1 egg
Speck of cayenne pepper	$\frac{1}{2}$ cup of scalded milk
2 teaspoonfuls of butter	3 tablespoonfuls of vinegar
2 teaspoonfuls of flour	

Put the dry ingredients together and stir them into the egg, slightly beaten. Put all the ingredients together, in the top of a double boiler, except the vinegar. Let them cook gently, stirring constantly, until they are thickened. Add the vinegar slowly and continue the cooking until the dressing is creamy. Strain and cool. If the dressing should curdle, beat it with an egg beater until it becomes smooth.

This dressing is especially suited to potato salad, simple vegetable and fish salads, and is liked by some persons better than a dressing which contains oil.

MAYONNAISE DRESSING

$\frac{3}{4}$ teaspoonful of mustard	Yolks of 2 eggs
2 teaspoonfuls of sugar	$1\frac{1}{2}$ cups of olive oil
$\frac{1}{2}$ teaspoonful of salt	2 tablespoonfuls of vinegar
Speck of cayenne pepper	2 tablespoonfuls of lemon juice
Whites of 2 eggs	

Have all the ingredients for the mayonnaise thoroughly chilled before beginning to blend the dressing. Mix the dry ingredients and stir them into the egg yolks. Add one tablespoonful of the vinegar and stir until thoroughly blended. Then add the oil, drop by drop, beating or stirring constantly, until the dressing begins to thicken, which is likely to be when the first quarter of a cup of oil has been added. After the dressing begins to thicken the oil may be added more rapidly without danger of curdling, but the beating must be constant. When the oil has all been added, beat in the whites of egg, already beaten stiff and dry. Chill and use as needed on salads.

The white of egg may be omitted, but it makes the dressing more delicate, lighter, and modifies the taste of the oil.

This dressing is used for chicken, lobster, and fruit salads, or, indeed, for any, when a rich dressing is desired.

POTATO AND CARROT SALAD

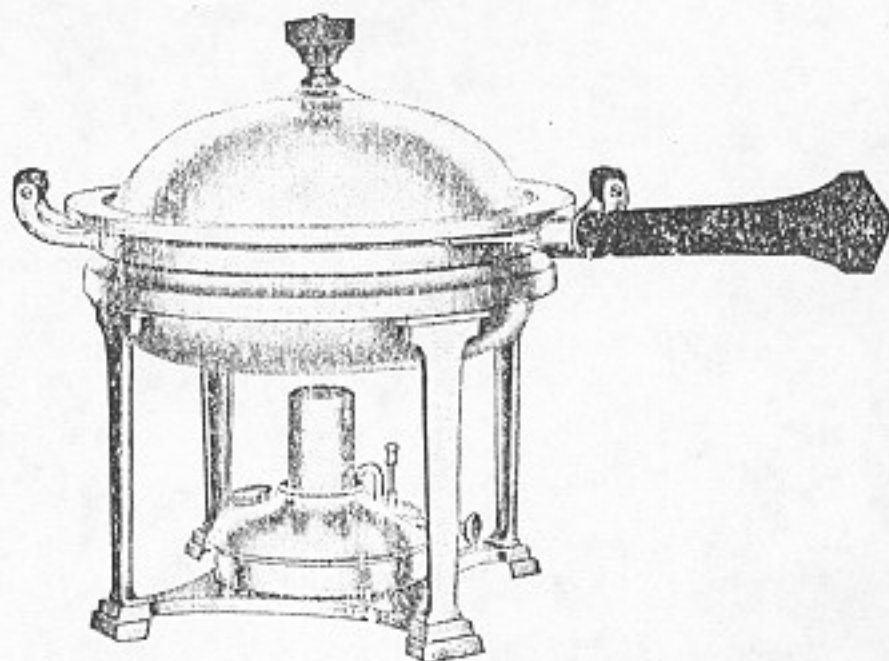
2 cups of potato, boiled, diced, and cooled
 1 cup of carrot, prepared as above
 2 hard-cooked eggs
 1 head of lettuce
 Salad dressing

Prepare the vegetables and lettuce. Cook the eggs and prepare them as for "egg golden-rod." Moisten the potatoes with a little French dressing or sprinkle them with salt, pepper, and vinegar. Arrange the lettuce on a bowl or platter, placing the stems towards the center of the dish. Put a mound of the potato upon the lettuce and garnish it with a border of the diced carrots. Pour over it the salad dressing and sprinkle it, in some dainty design, with the chopped yolk and white of the egg.

DATE AND CREAM CHEESE SALAD

Wash and stone the dates. Cut them into pieces and mix them with the cream cheese, which has already been softened with milk, cream, or salad dressing. Arrange the dates and cheese upon heart leaves of lettuce and serve with more dressing.

A dainty and attractive arrangement counts for more in a salad than in any other dish.



CHAFING-DISH COOKERY

THE chafing dish is a useful and often interesting means of preparing many dishes, when used either instead of a large stove or in addition to it. Many things may be cooked sociably at the table instead of in the kitchen. For college girls boarding themselves, for people living alone, and for late evening supper parties, it has many possibilities. The chafing dish need not be an elaborate or expensive one, nor need its owner in order to enjoy its use possess all the spoons, forks, fillers, etc., which may accompany it.

The chafing dish should have a good and easily adjusted lamp, unless one is very patient when hungry. There should be two pans, one called a "blazer," for cooking over the direct heat of the flame, the other for holding hot water, practically making a double boiler. There should always be a metal tray under the lamp of the chafing dish, to prevent injury to cloth on table in case the alcohol is spilled.

Many dishes which are prepared on the ordinary stove may be cooked also in the chafing dish, by the use of either the blazer or the hot water pan with the blazer, according to the heat required. White sauce with many kinds of fish, meat, vegetables, or eggs, eggs in many ways, cheese in the form of rarebit, and candy may all be prepared in the chafing dish. Have everything measured and daintily arranged before beginning the actual cooking, as this makes the work easier, more graceful, and less liable to interruption.

CREAMED CHICKEN

1 cup of white sauce	1½ cups of cold chicken
Salt and pepper	cut into small pieces
Crackers or slices of toast	

Prepare the white sauce in the blazer, being careful not to let it burn or become lumpy. Stir into it the cut chicken and heat over the hot-water pan. Season to taste and serve hot on crackers or slices of toast.

CREAMED SHRIMPS WITH PEAS

1 cup of white sauce	1 can of shrimps
1 can of peas	

Prepare the white sauce. Drain the liquor from the shrimps and the peas and stir them into the white sauce. Season with a little allspice, if liked. Reheat over the hot-water pan and serve hot on crackers.

OMELET WITH CHEESE

3 eggs	½ teaspoonful of salt
1 tablespoonful of butter	Speck of pepper
3 tablespoonfuls of milk	

Beat the eggs all together, add the salt and pepper and milk. At once pour it into the butter which has been melted in the blazer. Let it cook gently, lifting at the side and letting the uncooked portion run underneath. When it is firm, fold over and serve, sprinkled with grated cheese.

WELSH RAREBIT

½ pound of mild cheese	¼ teaspoonful of salt
1 egg	½ teaspoonful of mustard
Speck of cayenne pepper	¼ cup of milk
1 tablespoonful of butter	

Put the milk into the blazer, with the cheese cut into small pieces. Have the hot-water pan under it. Mix the seasonings with the egg and beat the egg slightly. When the cheese is melted in the milk, pour this liquid over the egg and return the whole to the chafing dish, still cooking it over the hot water. Stir it and let it cook until it is thickened and creamy. Serve hot on crackers. Be careful not to use too much heat, as it is likely to make the rarebit tough and stringy.

CREAM CHOCOLATE CANDY

2 cups of sugar	¾ cup of milk
2 squares of chocolate	1 tablespoonful of butter
1 teaspoonful of vanilla	

Boil together the sugar, milk, and chocolate until the chocolate and sugar are melted. Add the butter and cook, without stirring, until the candy forms into a soft ball, when a little is dropped into cold water. Remove from the heat, cool rapidly, without stirring at all until it is very cool, then add the vanilla and beat until it is creamy and ready to pour into the pan.

BROWN SUGAR FUDGE, WITH PEANUTS

2 cups brown sugar	1 tablespoonful of butter
⅔ cup of milk	⅔ cup of chopped peanuts
1 teaspoonful of vanilla	

Make this like the cream chocolate candy, adding the nuts with the vanilla. This candy must be boiled a little longer than the cream chocolate candy, that is, the ball must be a little firmer in this case than in that. In both candies one-eighth of a teaspoonful of cream of tartar may be added during the boiling, to make them less likely to crystallize.



OTHER SIMPLE RECIPES

HOT WATER GINGERBREAD

1 cup of molasses	1 teaspoonful of soda
½ cup of boiling water	2 teaspoonfuls of ginger
2 cups of flour	¼ teaspoonful of salt
3 tablespoonfuls of melted butter	

Mix and sift together the dry ingredients. Add the water to the butter and stir this liquid gradually into the dry mixture. When thoroughly mixed, add the melted butter and beat well. Bake about twenty-five minutes in a moderate oven.

ORANGE CAKE

Yolks of 2 eggs, well beaten	2 teaspoonfuls of bak-
1 cup of sugar	ing powder
1½ cups of flour	¼ cup of water
¼ cup of orange juice	

Sift together the flour and baking powder. Beat the yolks of the eggs thoroughly and add to them the water. Add the sugar and then the flour and orange juice, alternately. Cut or fold in a part of the stiffly beaten white of the egg just at the last, before putting the cake into the baking pan. Bake about twenty-five minutes in a moderate oven. The remaining white of egg may be thickened with confectioner's sugar and flavored, then spread upon the cake as frosting.

CREAM CAKES

1 cup of hot water	3 eggs
½ cup of butter	⅛ teaspoonful of salt
1 cup of sifted flour	

Let the water and butter come to the boiling point, then stir in the flour and salt and stir until it is a smooth paste, boiling it all the time but being careful that it does not burn. Let it cool, then add the eggs, unbeaten, one at a time, beating each one into the mixture before adding the next. Beat thoroughly, then shape by teaspoonfuls on a buttered pan or tin sheet. Do not put them too near together, as they spread a little in rising. Cook them about twenty-five minutes in a fairly hot oven. When baked, remove from the tin, and with a sharp knife cut open and fill with whipped cream or with any desired filling.

CREAM CAKE FILLING

1 cup of milk	4 teaspoonfuls of flour
⅓ cup of sugar	½ teaspoonful of flavoring
1 egg	Speck of salt

Scald the milk, leaving about two tablespoonfuls cold. Mix the dry ingredients and stir them to a smooth paste with the cold milk. Pour the scalded milk over this paste and cook until it thickens and is free from any starchy taste. Beat the egg slightly and pour the milk, etc., over it. Cook over hot water until it thickens smoothly. Remove from the heat, add the flavoring, strain, and cool.

The cream cakes are very good filled with crisp heart leaves of prepared lettuce which have been spread with either boiled dressing or with mayonnaise.

ICE CREAM

Ice cream is one of the most attractive and useful dishes, when properly used. It is not wholesome when eaten at the end of a heavy and elaborate dinner, after digestion has begun, since the chill of it may cause delay or even cessation of this process; but when eaten slowly, with simple food, it is refreshing and nourishing. Home-made ice cream, carefully prepared from clean and wholesome materials, is not to be placed under the ban, just because cheap ice cream, served in cones and sold in questionable places, is full of possible dangers.

Ice cream may be prepared in a real freezer or in one improvised from a pail and a bowl or from a baking powder can and a bowl. The principle of the freezing mixture, rock salt and ice, is the same in both cases. The ice must be chopped rather fine and must be mixed in layers with the rock salt. The salt melts the ice, which, in melting, steals heat from the nearest surfaces. These are, of course, the can of the freezer, packed within the ice and salt, and the tub of the freezer, which, being usually of wood, is a poor conductor of heat.

GENERAL RULES FOR FREEZING ICE CREAM

1. See that the freezer is clean and in working order, before beginning.
2. Have the ice chopped and the rock salt ready.
3. Prepare the mixture to be frozen and pour it into the can of the freezer.
4. Put the freezer together and pack it with the salt and ice. Use three or four times as much ice as salt. Begin with a layer of ice, then a layer of salt, and so continue until the freezer is packed above the level of the mixture within the can. Turn the crank occasionally during the process of packing.
5. Turn the crank slowly and evenly.
6. Add more salt and ice if needed. Do not pour out the water unless there is danger

of getting it into the ice cream. This water is the coldest thing about the salt and ice, and really does the freezing.

7. Remove the dasher and pack the frozen mixture down into the can. Put back the cover, pack with more salt and ice, and let it stand before serving.

8. In removing the can from the freezer and the cream from the can, be very careful that no salt is scattered into the cream. The can must be carefully wiped; and, if the ice cream sticks, the outside of the can may be wiped, quickly, with a clean cloth wrung dry out of hot water.

FRUIT SHERBET

1 orange	1 banana
1 lemon	1 cup of sugar
1 cup of berries	1 cup of water

Wash and squeeze the orange and lemon, using the tender pulp of the orange as well as the juice. Mix the sugar and water and add them to this juice. Peel the banana and scrape it with a silver knife. Press it at once through a coarse strainer into the juice and water, to keep it from discoloring in the air. The berries may be omitted, but, if they are used, wash them and mix with the other ingredients. Freeze by the general rule.

ICE CREAM

2 cups of cream	1½ teaspoonfuls of vanilla
⅔ cup of sugar	Speck of salt
	⅔ cup of milk

Mix the cream, milk, salt, and sugar. Add the vanilla. Freeze by the general rule. This may be varied by adding two-thirds of a square of chocolate, melted, for chocolate ice cream; one-third of a cupful of caramel sirup for caramel ice cream; or crushed strawberries or raspberries, using about one cupful.

ICE CREAM FOR ONE, WITHOUT A FREEZER

A baking powder can, absolutely water-tight, and a bowl make a substitute for a freezer. It is most useful for an invalid, in hot weather. Pack it as you would a large freezer, being careful constantly that the can does not

rise in the mixture of salt and ice. Turn the can with your hand after it is packed and now and then remove the cover and scrape the material down as it freezes against the sides. This hastens the freezing and makes the ice cream more even in consistency.

VANILLA ICE CRÉAM

½ cup of cream	2 teaspoonfuls of sugar
	¼ teaspoonful of vanilla

Scald the cream, dissolve the sugar in it; cool it and add the vanilla. Chill and freeze.

CARAMEL ICE CREAM

½ cup of cream	2 teaspoonfuls of sugar
	1½ tablespoonfuls of caramel

Scald the cream and dissolve the sugar and caramel in it. Chill and freeze.

LEMON ICE

½ cup of water	3 tablespoonfuls of sugar
	2 tablespoonfuls of lemon juice

Boil the sugar and water together and strain into this sirup the lemon juice. Chill and freeze.

FIRELESS COOKING

FIRELESS cooking sounds like a contradiction — an impossibility; but think of the comfort and convenience of it on a hot day, or when one wishes for any reason to be away from home. The Norwegian "haybox" was the forerunner of the present more elaborate "fireless cooker," with all its pretty aluminum kettles and easily adjusted parts.

Everything cannot be cooked in a fireless cooker, but dishes such as cereal, stewed fruit, and vegetables, braised meat, and fish cooked in water are perhaps better cooked in this way than in the usual manner. Foods that require high heat for a short time, such as toast, crisp fat of meat, and bread or muffins must still be cooked in the oven. The principle of the fireless cooker is that the heat is retained by a non-conducting medium, so that the cooking is carried on after the direct heat of the fire is removed. This means the utilization of heat which usually escapes

and is' wasted, through radiation from the kettle and the loss of steam.

If you have a real, bought fireless cooker, follow the directions carefully and, with your knowledge of the principles of cookery, you will be able to use the cooker successfully. If you wish to prepare a cooker at home, you must begin with a wooden box or old trunk which can be tightly closed with a hinged and fastened cover. The kettle must be at least two inches smaller in every dimension than the box in which it is to stand.

The kettle must have a cover which fits securely. Good agate-ware or aluminum are the best materials for the kettle. Aluminum costs more to begin with but is most durable.

The box may be packed with hay, excelsior, paper, etc. Some packing, such as wool and sawdust, must be covered to keep them in place.

TO PACK THE BOX

1. Line the box and the cover with several thicknesses of newspaper.
2. Make a thick layer of newspapers at the bottom of the box.
3. Place the kettle on this pad, in the space where it is to stand, and pack it tightly with newspapers or other packing material. When the kettle is taken out, it will leave a nest just right to slip it into next time.
4. Make a bundle of papers to fit the top firmly.
5. If on using, the packing material shrinks from the box or kettle, add more papers to keep the space firmly filled.

HOW TO USE THE COOKER

1. Do not try to prepare too small a quantity in the cooker, as it loses heat more rapidly in proportion than a larger amount.
2. Have the cooker open and everything in readiness near the stove. Heat your cereal, stew, fruit, or other material, to the boiling point and then, when it is *all* thoroughly boiling, put on the cover tightly and transfer it quickly to the nest in the cooker. Close the cooker at once and do not open it again until the time of removing your dish. If you do, it will be necessary to reheat your food, since

so much heat will be lost that the cooking cannot continue.

CREAM OF WHEAT MUSH

4 cups of boiling water 1 teaspoonful of salt
 $\frac{3}{4}$ cup of cream of wheat

Mix the salt and boiling water, then scatter in the cream of wheat, and boil five minutes. Put it in the cooker and cook at least two hours. It may cook ten or twelve hours.

OATMEAL

$\frac{1}{2}$ cup of oatmeal $\frac{1}{2}$ teaspoonful of salt
 $\frac{3}{4}$ cup of cold water $2\frac{1}{2}$ cups of boiling water

Soak the oatmeal in the cold water for several hours. Add it to the boiling, salted water and let it boil ten minutes, uncovered. Place it in the cooker and cook over night, or about ten hours.

STEWED PRUNES

Wash the prunes *very* carefully, then soak them in cold water over night, if possible. Put them on to boil in the same water in which they were soaked, and let them boil five to ten minutes. Add about one tablespoonful of sugar for each cup of prunes, or more if liked. Then put them into the cooker and cook about eight or ten hours.

Apricots may be cooked in the same way except that they may not require so long a time, and must not be allowed to break.

CORN CHOWDER

1 inch cube of fat salt pork 1 onion
 4 good-sized potatoes 1 can of corn
 1 quart of milk Salt and pepper
 $\frac{1}{2}$ box of oysterettes 2 tablespoonfuls of butter

Cut the pork and onion into small dice and fry them together. Prepare the potatoes, cut them into dice, and parboil them five minutes to remove the bitter taste. Put the milk, potatoes, corn, and seasoning into the cooker with the onions and pork, and cook two hours.

ITALIAN STEW

5 tablespoonfuls of olive oil 1 can of tomatoes
 1 onion 1 can of peas
 4 good-sized potatoes Salt and pepper

Cook the onion, cut into dice, in the olive oil until it is light brown. Add the tomatoes and peas and the potatoes, cut *very* thin. Season and let boil five minutes. Transfer to the cooker, and cook three or four hours. Macaroni broken into pieces may be substituted for the potato, and dried mushrooms may be added if liked.

LUNCHEONS FOR SCHOOL, TRAVELING, OR PICNICS

EVERYBODY likes a dainty, satisfying luncheon when one must be carried to school or on a railroad journey or to a picnic ground. And it is not an entirely simple

matter to arrange one which will keep its attractiveness after it has been jolted about for some hours. The food must be chosen carefully, so that it may not be too perishable. The way of packing, too, is very important. Never try to pack and carry food which may really spoil on a long, hot trip. Never pack food in such a way as to make it too heavy or bulky for easy carrying.

Have a drawer or shelf, somewhere, in which to keep, in a neat and handy fashion, the papers, string and clean boxes which may be useful for arranging luncheons. With these it is well to have, also, drinking cups, paper plates, paper napkins, common forks and spoons, and little glass or porcelain jars such as jam, cheese, etc., come in. Then, when someone suddenly decides to go for a journey, or an unexpected invitation comes to join a



A BASKETRY CLASS HAVING A PICNIC

picnic party, you are prepared to pack your luncheon comfortably, quickly, and daintily.

SANDWICHES

Sandwiches may well be the chief part of most luncheons. They can be carried well, are very nourishing, and may be prepared in any number of kinds, by varying the filling. The bread should not be too fresh to cut well and should be cut into slices as thin as they may be without breaking when spread with the butter and filling. Soften the butter with a silver knife, until it is light colored and creamy. Spread one slice of bread with butter and the next with the sandwich filling, being very careful to keep the slices in pairs, so that they will fit evenly together. Do not cut off the crusts, unless you are preparing the sandwiches for an afternoon tea, where you wish them to be particularly delicate. The crust is almost the best part of the bread.

The filling for sandwiches may be chopped meat with butter or salad dressing, chopped egg with salad dressing, cream cheese softened with milk or cream or salad dressing and mixed with chopped olives, raisins, or nuts. Lettuce leaves, freshly washed and dried, may be spread with salad dressing and laid between the slices of bread and butter. These must be eaten soon after they are prepared, as the lettuce wilts quite quickly. Jelly sandwiches, or jelly mixed with chopped nuts, are refreshing in a luncheon where there is perhaps little to drink. When the sandwiches are done, wrap each in paraffine paper and then wrap the whole package in stout paper or pack in a box by itself.

STUFFED EGGS

Cook the eggs hard by placing them in water that is boiling, then at once lowering the heat to just below the boiling point and letting them cook for thirty minutes. Remove the shell and skin and, cutting them in halves, lengthwise, remove the yolks without breaking the whites. Mash the yolks with a little salad dressing or mix them with deviled ham or butter, salt and pepper, then shake into balls and fit them back into the empty whites. Lay the halves to-

gether and wrap each egg securely in paraffine paper.

If your picnic is out-of-doors in a place where you can have a fire or even an alcohol stove, it will add very much to your pleasure to cook something on the spot. Coffee is as simple as anything to prepare and almost everyone likes it at an out-of-doors fête, even if not at home.

COFFEE

Put in a cheesecloth one tablespoonful of coffee for each cup you wish to have. Tie the cheesecloth securely, but do not have it tight, as the coffee swells when it is soaked. Put the coffee, thus arranged, in a coffee pot or pail and cover it with cold water. Let it stand a little while and then pour over it one cup of boiling water for each tablespoonful of coffee, except one. (That one tablespoonful is to allow for the cold water in which the coffee was soaked.) Let it boil three minutes, then let it settle five minutes, where it will keep hot but no longer boil. Serve hot with sugar and cream.

Soup may be heated over the fire, or eggs may be cooked. Be very careful that you never try to make a fire in the open unless you have a perfectly safe place to make it in. Never start one in dry or windy weather. Forests are too precious to be hazarded for the mere pleasure of a picnic fire.

A thermos bottle is a great convenience and comfort in carrying hot or cool beverages on a train, for one or two persons. A pail may be arranged so that hot or cold food or drink for a larger number may be carried to a picnic. The principle is that of the fireless cooker. Food may not, perhaps, be cooked in this pail, which can easily be arranged cheaply at home, but it can be kept at an agreeable temperature for some hours. There must be two pails, each with a securely fitting cover, and the outer one must be about two inches larger, in each dimension, than the inner. The space between the two pails must be firmly packed with newspapers, excelsior, or hay; the bottom and top of the inner pail must also be solidly protected by layers of newspaper or other packing. If the inner pail, after being filled and tightly covered, is heated to the boiling point and at

once packed into the space already prepared, the food will remain very hot if not actually cooking. Ices, packed in the same way, will keep for a long time, protected by the layers of newspaper. It is well to have the outer pail wooden, if possible.

When you have finished your luncheon pick up and safely bury every scrap of rubbish, egg-shells, fruit skins, paraffine paper, etc., which may have escaped during your eating. Leave your picnic ground as dainty as you would like to find it, so that the wood-lovers, both fairy and human, will not regret that you came and will welcome your return.

HOUSEKEEPING

"The woman's work for her own home is to secure its order, comfort, and loveliness."—JOHN RUSKIN.

A GIRL'S OWN ROOM

THE first bit of housekeeping intrusted to a girl's care is usually her own room; then, when she has learned to keep that in dainty order, some other parts of the house may be allotted to her responsibility, until she has become acquainted with every side of housekeeping.

A girl's own room should be, so far as possible, an expression of her own taste. The furniture may be of the simplest, yet it should be carefully arranged and well cared for. There should not be too many knickknacks about, to catch dust and make the matter of keeping tidy too difficult.

BED-MAKING

1. When you get up in the morning, at once open the bed and spread the bedclothes over the footboard and chairs. Open the windows, closing the door in winter to keep the rest of the house from becoming cold.

2. After breakfast, when the bed has aired thoroughly, make it up neatly. Turn the mattress at least every other day, then lay the pad straight and smooth upon it. Always arrange the sheets with the wide hem at the top of the bed and the right side towards the sleeper. Tuck the lower sheet in at the top, very firmly, and the upper one in at the bottom so that it will not pull out. Do not let any wrinkles

remain in either sheets or blanket. Turn the sheet down at the top to cover the blanket edge and lay the spread smoothly over all. Tuck it in along the sides or let it hang down, according to the kind of bed; then shake up the pillows and lay them smoothly in place.

KEEPING IT IN ORDER

Hang up your clothing, if any is not in its place. Put away your shoes and arrange anything about the room which has been left in disorder. Make your closet tidy each day and then it will seldom need a thorough overhauling. Put your bureau drawers in neat order and keep your belongings in place by means of open boxes, which will fit into the drawer and separate handkerchiefs from gloves and so on. It is better to "keep it tidy" than to set it to rights only every now and then.

Wash your toilet articles every morning and dry them, being especially careful about your soap dishes. Arrange the things on your bureau and do not leave pins, brush and comb, or other things, lying about.

Dust your room and arrange your table and desk or sewing table. A room which is well cared for is very attractive and inviting even though plain. Your own room is your "home in your home."

THE BATHROOM

No room in the house should be more neat than the bathroom, and a little care will keep it constantly in order. In the morning shake the rug and wipe up the floor, then dust the woodwork carefully. Scrub the tub and bowl with some scouring soap which will not scratch, and rinse them thoroughly with hot water. Be sure that no gray ring is left. Scrub the top of the washstand and clean the faucets, but be careful, if they are of nickel, not to use a powder that will scratch them. Usually hot water and soap will be enough, but silver polish may be used if necessary. Clean the toilet with a brush made for that purpose, or with a roll of stiff paper that may afterward be burned. Take away the used towels and put out fresh ones. Be especially careful to see that the soap dishes are clean and dry.

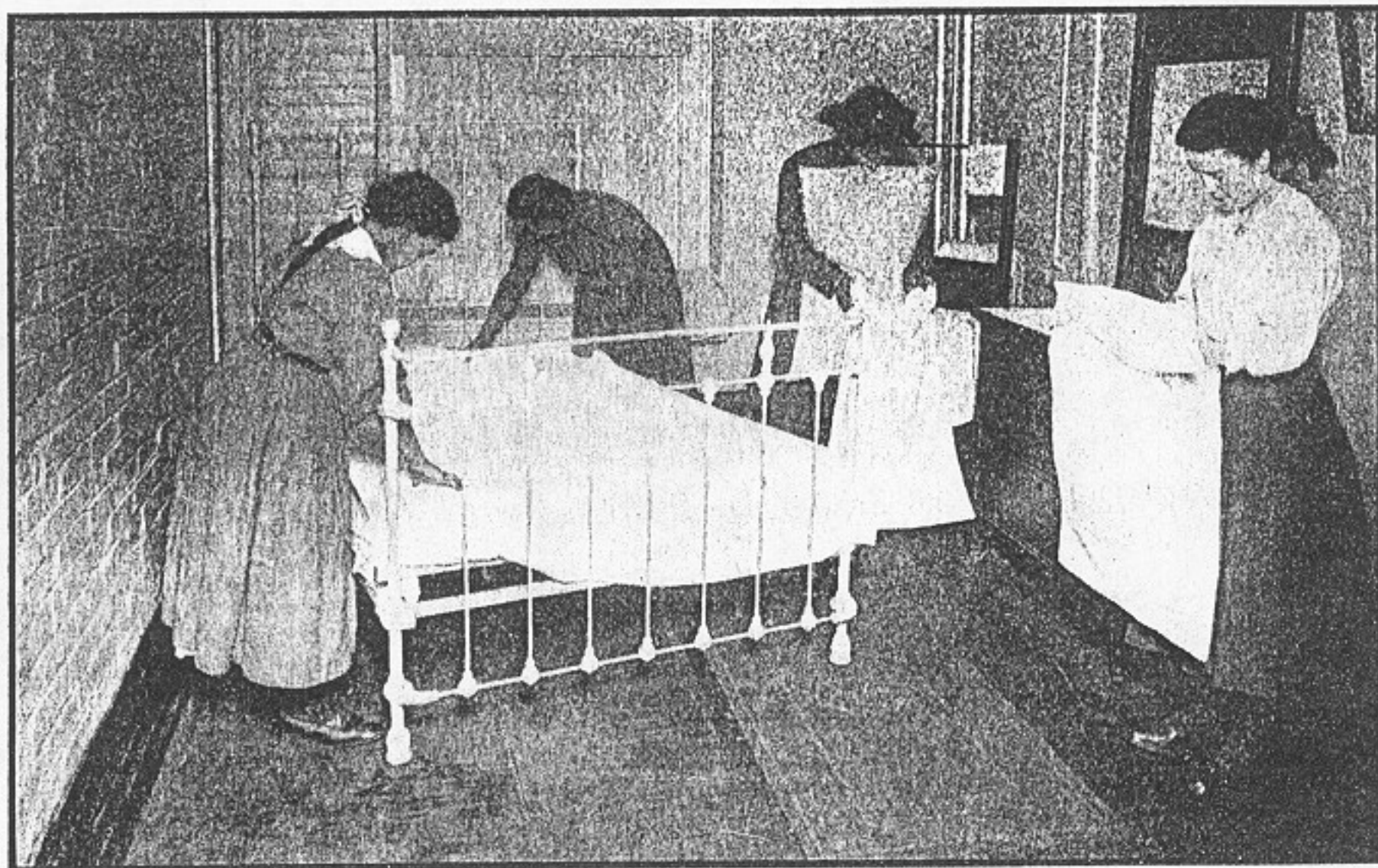
THE LIVING ROOM, PORCH, AND HALL

The first thing in the morning, when you go downstairs, open the front door and let it remain open while you sweep the porch. This will freshen the air throughout the house and insure an attractive, tidy entrance from early morning. Shake out the small rugs in the hall and wipe up the floor, if it is bare, with a dry mop. Dust the hall furniture and set it in order.

it is well to have fresh air entering, at least by a window-board.

THE DINING ROOM

Before beginning to get breakfast, open the dining room windows. Wipe up the floor and brush the rug or carpet, if necessary, to remove crumbs. Dust thoroughly; then close the windows and lay the table.



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PRACTICING BED-MAKING AT SCHOOL

If the living room is put in order every night just before bedtime, it is easier to take care of next morning. Carry away old newspapers, arrange books and magazines, brush up the carpet or shake rugs and wipe up the floor, and dust each piece of furniture. Remove any faded flowers, wash the vases, and replace with fresh bouquets, if you can. Clean and fill the lamps if they are used. Be sure, too, that the living room is well aired. At least once a day the windows should be opened and a free draft of air should be allowed to enter and wash out every trace of the air which has been lingering in the corners and hangings. At all times,

Every family makes its own rule for table setting, since this must vary according to the time, place, and means at hand. Absolute cleanness and order, however, will make the simplest linen and china very dainty and attractive, even if it is not arranged according to the latest fashion. Convenience in serving and eating should be the foundation for table arrangements. If flowers are used on the table they should be fresh and daintily arranged. Never use too large a bouquet, as that is inconvenient in many ways.

Table setting may vary in kind and in elaborateness from this simple little Japanese table

to one loaded with flowers, candles, and ribbons, such as we see sometimes in foreign cities. I think we all prefer simplicity and daintiness, which approaches the Japanese ideas, though we may require more dishes and different arrangements from theirs.



RULES FOR SETTING THE TABLE

1. Dust the table carefully.
2. Lay on it the silence cloth and tablecloth, or the runners or doilies. Runners and doilies are more easily kept fresh and dainty.
3. Put the knives and spoons at the right of each person's plate, turning the knife edge towards the plate and laying the spoons to be used in order, so that the outside one is taken first. The forks are placed at the left, in the same order.
4. Put the tumbler at the right hand, at the end of the knife. The bread and butter plate and napkin should be placed at the left.
5. Cocoa, coffee, or tea should be served at the mother's place. Arrange the sugar bowl and cream pitcher in front of her, with a bowl for dregs, and with a tile for both the hot-water pot and the cocoa pitcher or coffee or teapot. The hot water should be on the left, the beverage on the right. Cups and saucers with spoons should be set at hand as conveniently as possible.
6. Opposite the hostess, arrange a place for serving the breakfast or luncheon dish, with a mat of some sort to prevent the heat from injuring the table, and with spoons, knife and fork, and plates suitable to the kind of food to be served.

THE KITCHEN

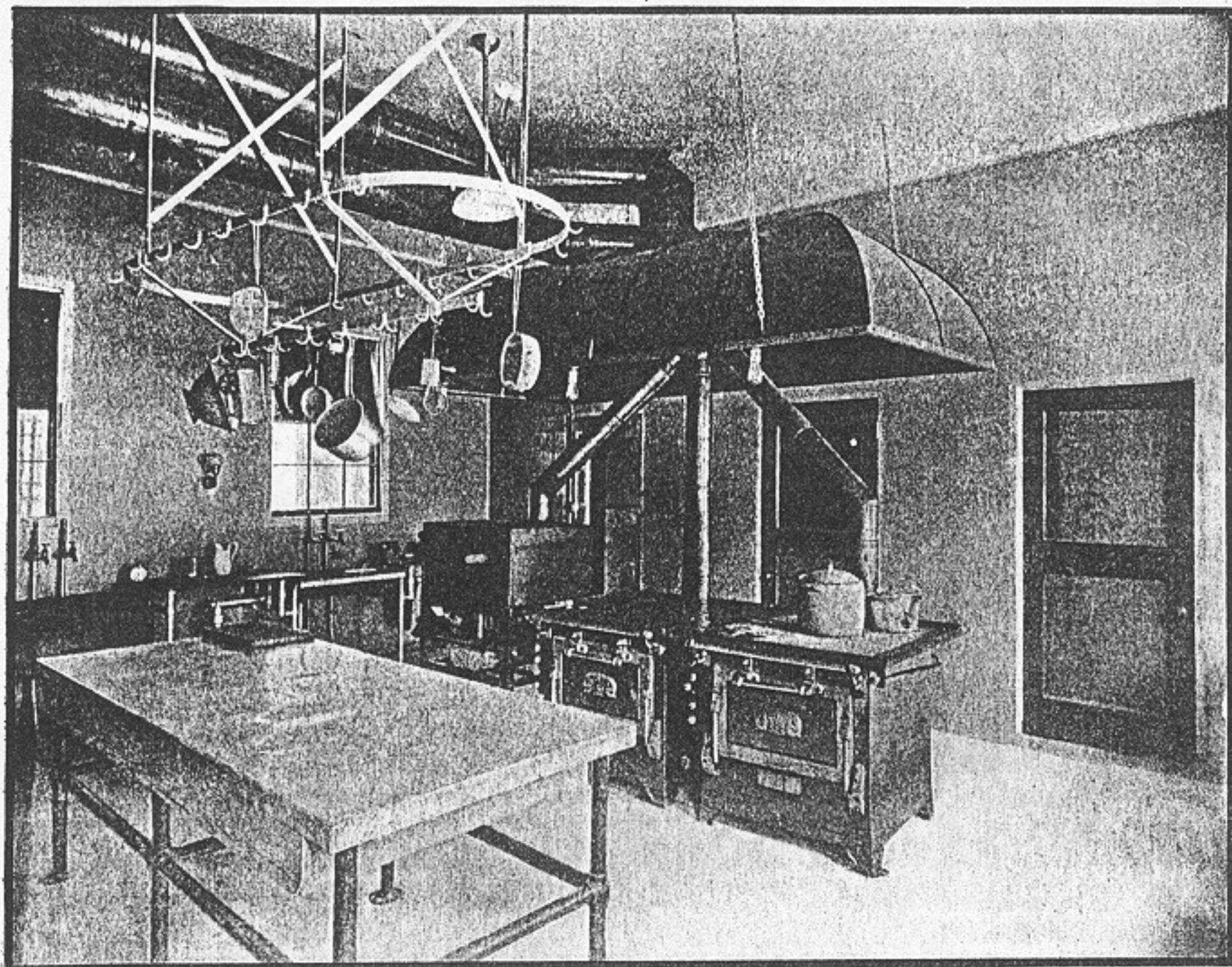
The kitchen should be one of the most attractive and inviting rooms in the whole house. Its charm consists almost wholly in its cleanness and its simplicity. The kitchen should be a light, well-aired room, both for the comfort of people who work in it and because sunshine, light, and air keep things sweet and clean. Here, as in other parts of the house, care in keeping things dainty will save you a great deal of trouble in making them clean again if you should at any time be careless. Wipe spots from the floor before they have time to stain, and brush up crumbs and litter as soon as they are scattered.

RULES FOR DISH WASHING

1. Have plenty of hot, soapy water.
2. Have plenty of clean towels.
3. Gather up the dishes and scrape off any scraps. Grease may be rubbed off with a piece of soft paper that can be thrown away. This is especially necessary in the country or in a camp where water is not too plentiful or must be carried a distance.
4. Soak dishes which have held eggs, milk, or dough in cold water. Soak dishes which have held sugar, fat, or gelatine in hot water.
5. Wash all dishes both inside and outside. Rub any rough or burned spots with Sapolio. The worst burned spots may be readily removed with a small bit of steel wool, that may be bought at the hardware store.
6. Rinse the dishes carefully in very hot water and wipe entirely dry, holding them in the towels so that your fingers do not make dull marks upon them.
7. Wooden, celluloid, or ivory knife and fork handles must not be left in hot water. Do not wet the egg-beater above the wheels, as the oil is washed away and the egg-beater will be very hard to run.

CARE OF TOWELS

Wash the towels out in hot, soapy water after each meal. Once a week they should be sent to the laundry. They need not be ironed, but stretched smooth and even. Some people prefer unironed towels and bed linen as seeming fresher and softer than when ironed.



A MODEL KITCHEN, SHOWN IN A SCHOOL

THE SINK

Keep the sink like a big dish, never allowing anything to accumulate or become disagreeable in it. Then the work is never unpleasant.

1. Remove any scraps which may have fallen into the sink.

2. Clean the sink thoroughly with Sapolio or any good sand soap and a brush.

3. Rinse thoroughly with hot water.

4. Scald the sink drain thoroughly, and once a week pour down a solution of hot washing-soda. Wash the soda down, in its turn, with plenty of hot water.

5. Wash out the dish mop or dishcloth and wring it very dry; then dry it in a draft of fresh air. Wash the sink cloth and air it. Keep cloths for their own uses and never use them interchangeably.

CARE OF THE STOVE AND FIRE

Sometimes you may wish to make a fire. This is a necessary and useful part of house-keeping and cooking, but be always careful that you understand what you are about, for the fire which is so good a servant in skillful hands becomes a most terrible master if you are careless. In every kitchen there should be some woolen rug or table cover or blanket, to wrap about any person whose clothing might take fire, so as to smother the flames. The very worst thing for the endangered person to do in such a case is to run, for this fans the flame, which might at first be easily put out. If alone, lie down at once, as this keeps the flame away from the face, and then roll over and over, towards a rug, if one is near. The rolling itself helps to put out the fire. At bonfires this

might be done on the grass, but children should wear woolen clothing at bonfires and should be taught never to play with matches or with fire in any form. It is not unsafe to learn to build a fire in the stove, if you take care, and it is an important thing to understand.

1. See that the grate of the stove is empty and clean.

2. See that the drafts are arranged properly for starting the fire: check draft closed, other drafts open.

3. Lay the fire, first using shavings or crumpled newspapers, then soft, light wood.

4. Brush the dust and chips off the top of the stove; also brush out the oven and brush around the stove.

5. Blacken the stove.

6. Light the fire, from underneath the grate.

7. Polish the stove while the fire is kindling. Begin to rub on the front covers.

8. When there is a good wood fire, add coal carefully; and close the oven draft, when the coal is beginning to burn without smoke and gas.

9. Add more coal, and close the front draft and chimney draft to keep the fire.

CARE OF THE ICE CHEST

As often as twice a week, take everything out of the ice chest and wash it thoroughly inside with warm water in which there is a little soda. Once in a while, when the ice chest is empty and you can spare time for it to cool, scald it out with boiling water and pour hot soda solution into the drain. Never allow anything to spoil or to be spilled in the ice chest. Keep no strong-smelling things, such as cheese, fish, or onions, where they can give a disagreeable taste to milk, cream, or butter.

CARE OF FOOD

Put away food at once, when it is brought in from the market or when a meal is over. Milk and cream must be taken in as soon as the milkman brings them and be placed at once on the ice. If you have no ice, stand the jars in cold water and cover them with a wet cloth which dips into the water. In this way the

cloth will remain wet and the evaporation from its surface will keep the jars cold. Wash eggs when they come in and put them away. Cover everything very carefully from dust and flies, — but don't have any flies!

SWEEPING AND DUSTING

Before beginning to sweep, dust and remove small ornaments, or cover them in the room. Use some moist thing, such as wet tea-leaves or pieces of wet newspaper, to keep the dust from flying as you sweep. Keep the brush close to the floor and sweep with long, even strokes, with the nap of the rug or carpet. Shake small rugs or brush them out-of-doors. After sweeping, with a soft cloth or dustless duster wipe off the pictures and woodwork. Then bring back and rearrange the ornaments and furniture which you dusted beforehand. Never use a feather duster. It is an "abomination," which only stirs up dust for people to breathe, without removing it, so that later it settles again and the work is worse than wasted.

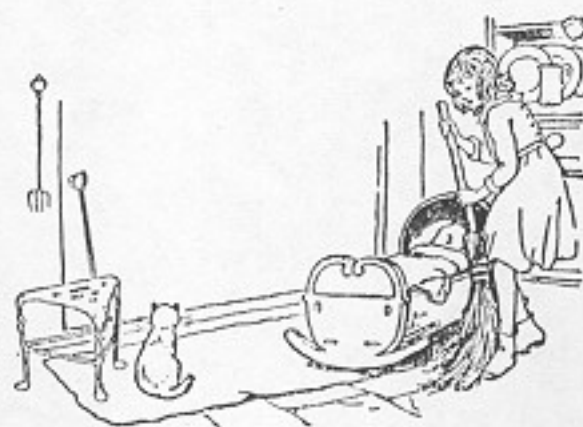
METAL CLEANING

1. Silver should be rubbed with a good silver cream or powder. It must *never* be touched with anything which can scratch it. Polish it when the powder is dry, then wash it in clean hot water.

2. Steel may be scoured with Sapolio or Bristol brick. Put it on with a wet cork. Wash and dry the article, as steel rusts if left at all damp.

3. Copper and brass may be cleaned with salt and vinegar, with rotten stone and oil, or with a good brass polish.

4. Nickel should be washed with soap and hot water and, if that is not sufficient, cleaned like silver. It must not be scratched.



Boomerang Throwing is Great Sport

by Keenan
H. Ward

POPULAR MECHANICS

OCTOBER, 1928

ZIP! Away it goes, skimming the surface of the ground for a distance of 250 ft. or more, and then, rising like a bird in its flight, it wheels and comes hurtling back to the thrower, landing almost at his feet. Believe it or not, there's real fall sport in boomerang throwing.

The boomerang comes from Australia, where the flat country makes an ideal arena for their manipulation. The little brown Bushmen of the Arunta tribe, who depend on them almost entirely for hunt and defense, make no less than twenty different forms of boomerangs, ranging all the way from a 14-in. bird stick to the heavy 4-ft. war boomerang.

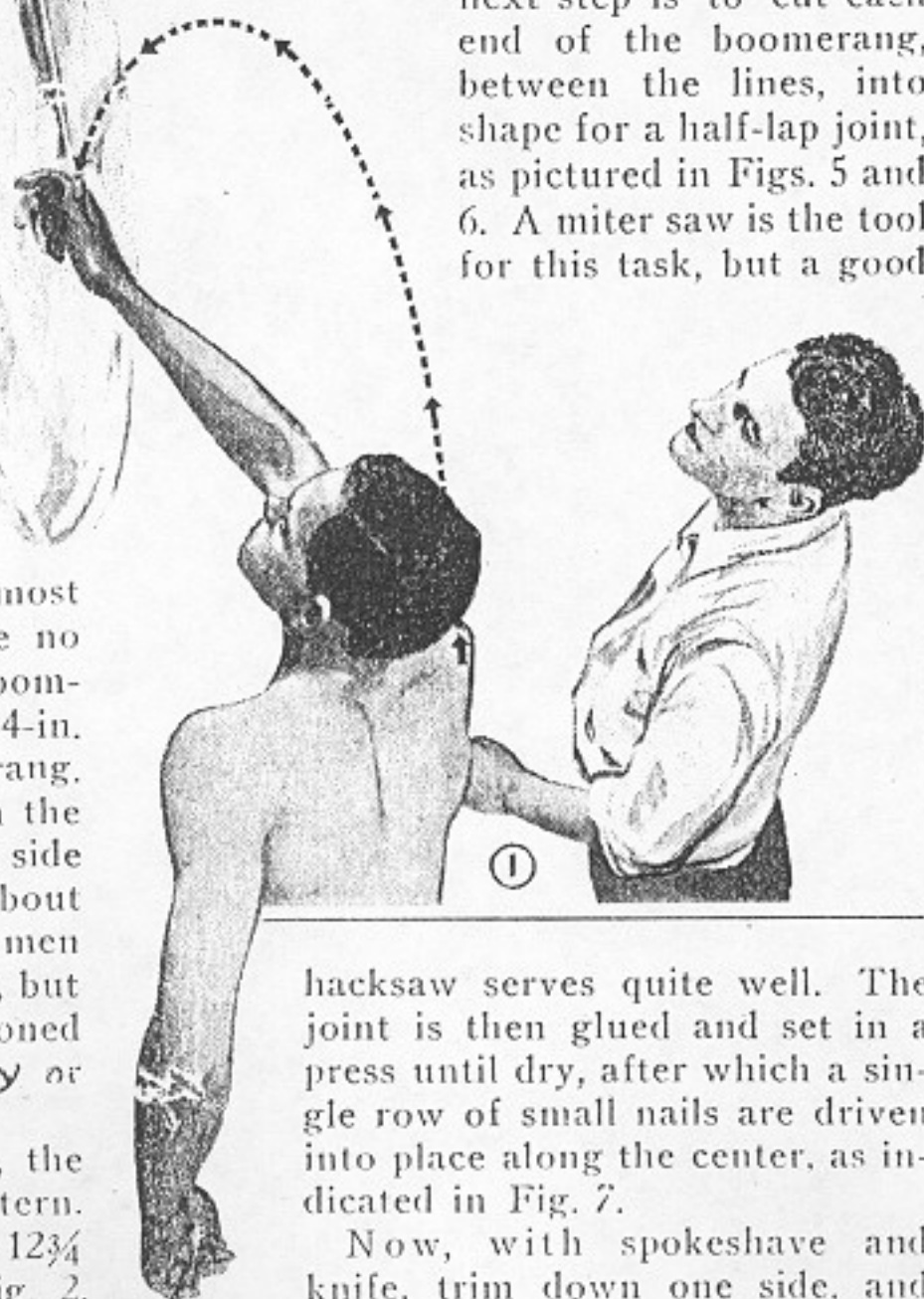
Most Australian boomerangs are in the shape of an obtuse triangle, flat on one side and convex on the other, measuring about 2½ ft. from tip to tip. The brown men use acacia wood in their construction, but your homemade one can be fashioned quite nicely from a piece of hickory or second-growth ash, ⅝ in. thick.

In making your own boomerang, the first step is to map out the paper pattern. Do this on a sheet of paper, 29½ by 12¾ in. The paper plan is shown in Fig. 2.

Only a rough adherence to the plan is necessary in order to insure a successful boomerang. Note that the width of the boomerang arms, near the angle, is 2 in., while they narrow down to 1⅞ in. at the rounded extremities.

Cut out your paper model and draw two lines across it in positions somewhat similar to those shown in the lower drawing. Now, place your pattern on the wood stock and trace out each half of the boomerang, as in Fig. 3, the portion of the pattern between the two lines being part of both halves. After the outline has been penciled in, take a keyhole saw and

cut out the two portions, as shown in Fig. 4. The next step is to cut each end of the boomerang, between the lines, into shape for a half-lap joint, as pictured in Figs. 5 and 6. A miter saw is the tool for this task, but a good



hacksaw serves quite well. The joint is then glued and set in a press until dry, after which a single row of small nails are driven into place along the center, as indicated in Fig. 7.

Now, with spokeshave and knife, trim down one side, and

one side only, of your boomerang to a convex shape, as shown in Fig. 8. In shaving, only the sharp edge is taken from the wood at the center in order to leave the joint almost full strength, but the remaining part is cut down to a feather line at the edge while retaining the full $\frac{5}{16}$ -in. thickness at the center line.

Additional nails are then driven into the joint, and aluminum reinforcing strips, cut to shape with tin snips, are nailed to the center and tips of the boomerang on the flat side, as shown in Fig. 9.

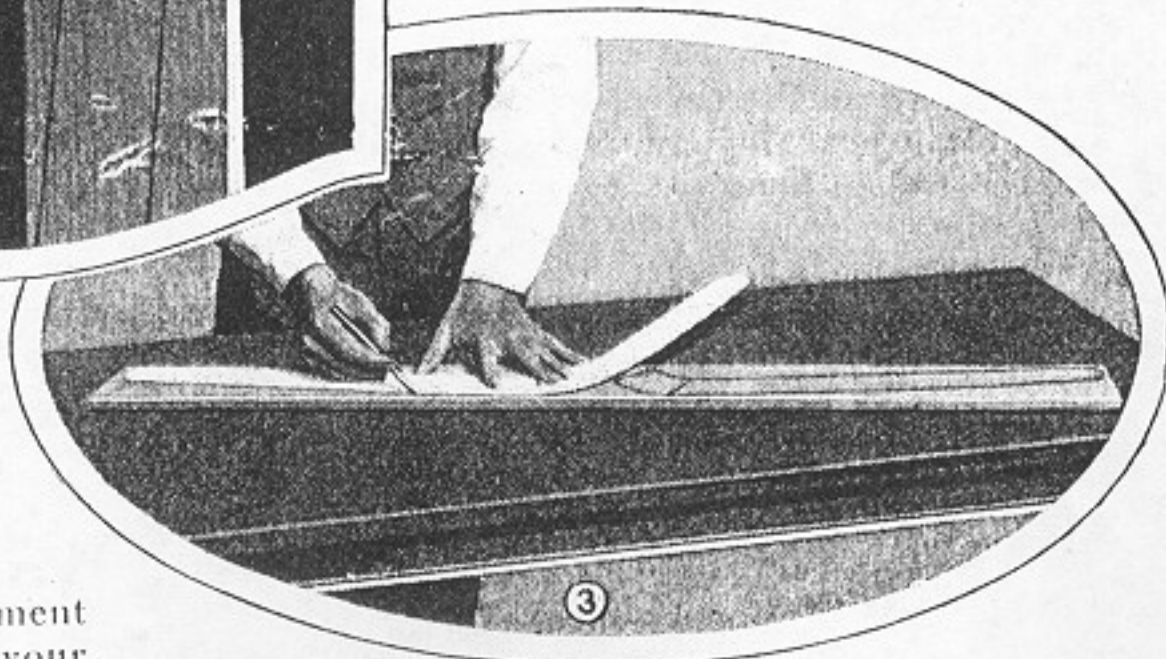
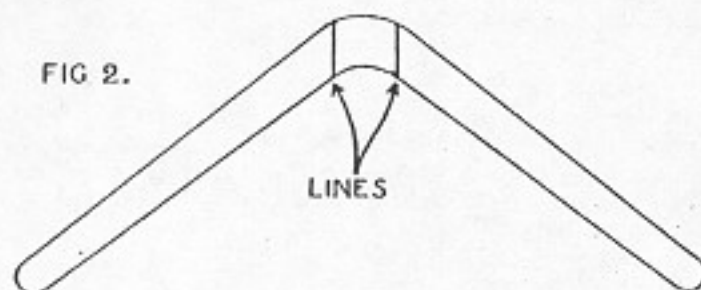
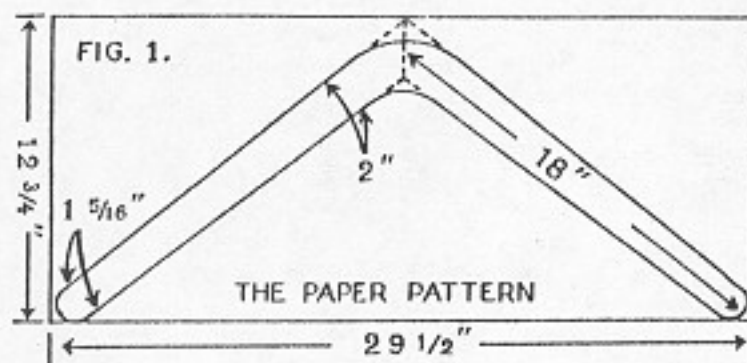
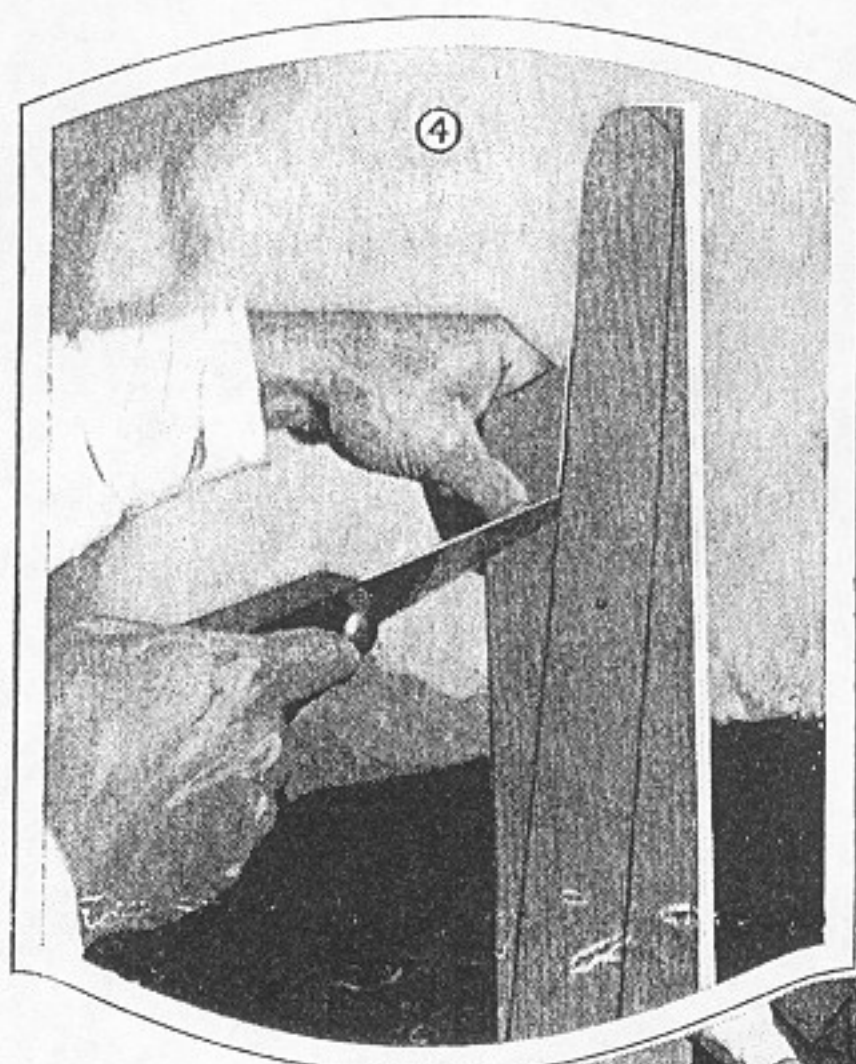
The final operation, Fig. 10, consists in giving the whole thing a coat of stain or varnish. A bright color paint should be used instead of stain if you are contemplating throwing in deep grass, in order to make the boomerang more distinguishable where it falls.

And now to the throwing. The average person thinks that the throwing of a

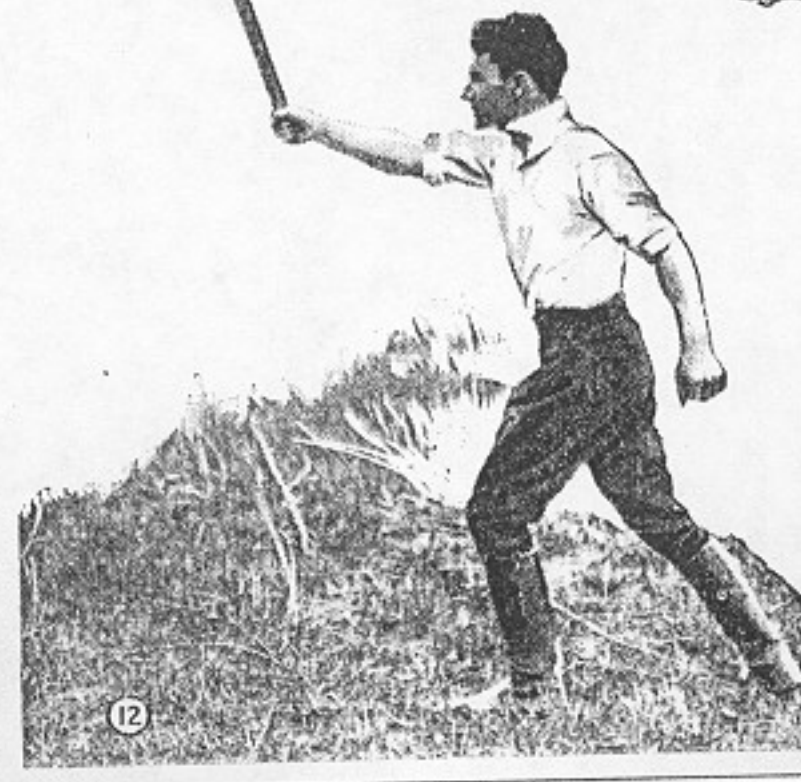
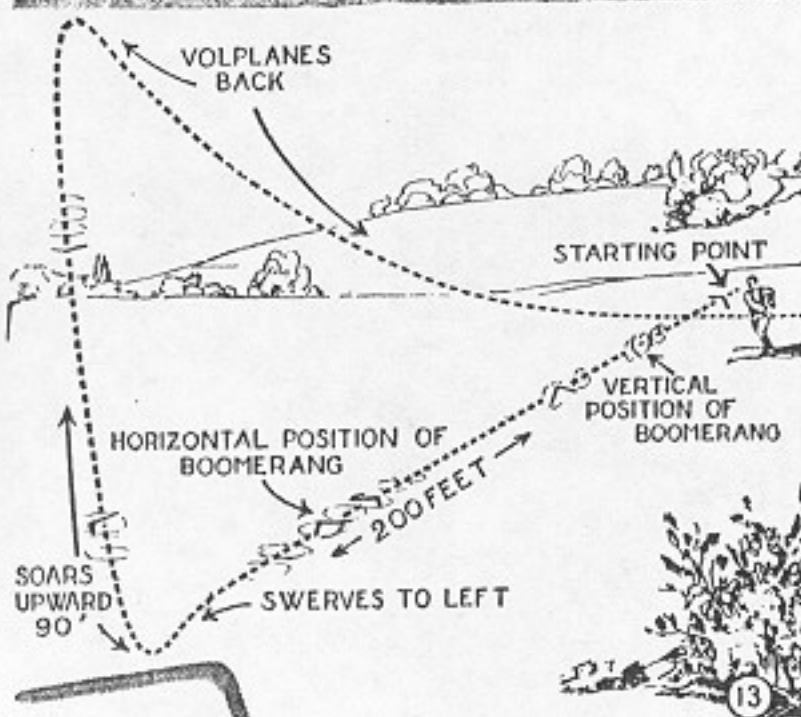
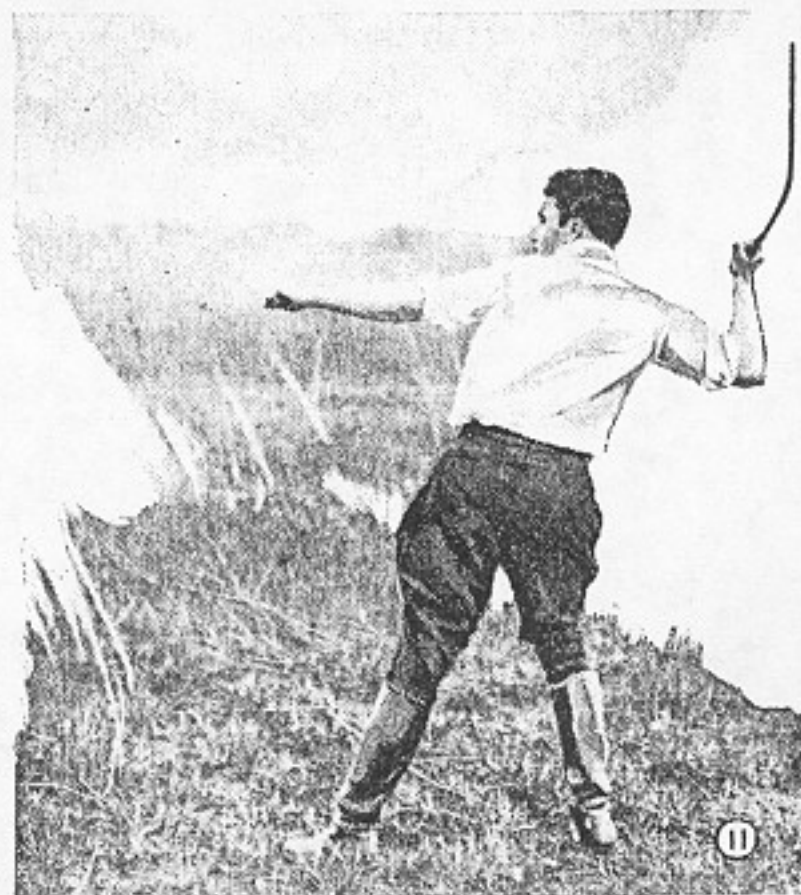
own far more readily than the pulling of a forty-pound longbow.

The first rule is that the boomerang must always be thrown against the wind. It is against the wind only that the magic stick is self-retrieving.

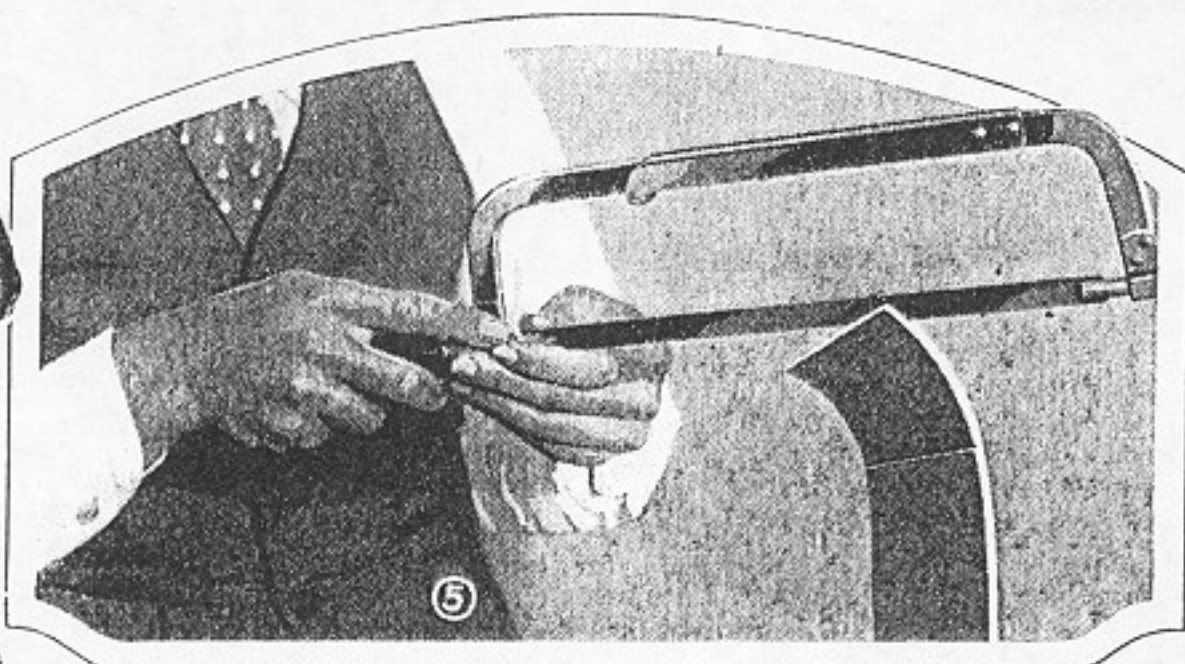
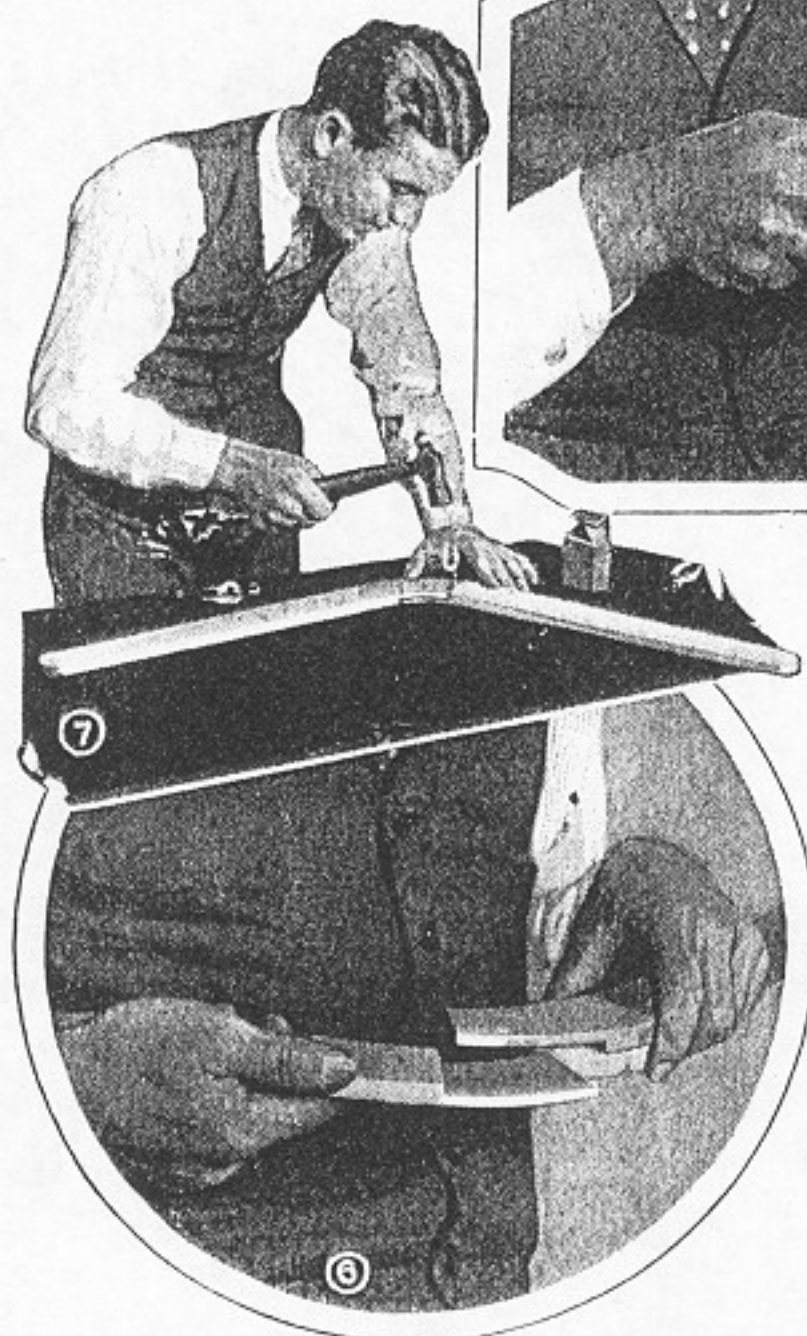
So, facing the wind, you hold the boomerang in your right hand with the rounded side inward; that is, the round side should be the left side of the boomerang, when held in throwing position by a right-hand thrower. Holding firmly to one end, bring the stick over your head until you reach the position shown in Fig. 11. Then, bringing the arm forward in a straight overhand swing to the position shown in Fig. 12, release the stick with a short upward jerk of the hand, somewhat like that used in cracking a whip. This is important. Without this sharp jerk, the boomerang gets off to a slow spinning start and will not revolve fast enough to



boomerang is something which can only be acquired through long and continuous practice, but that idea is entirely erroneous. Throwing the curving stick is an accomplishment which you can make your



make the return journey; with the snap correctly done, the



The parabolic flight of the boomerang is a beautiful thing to witness. Although the throw is generally as described, the magic stick can be made to perform a score of other graceful arcs. A slight variation of the snap, a small deflection of the throwing angle, and the boomerang can be made to shoot inward with terrific swiftness, curve outward in a lazy arc, or shoot upward in spinning flight. Almost any object, be it a rabbit hiding behind a stump or a pheasant on the wing, is a fit mark for the flying stick.

After some proficiency has been gained in directing the flight of the boomerang, you can erect a target consisting of a burlap sack filled with straw and aim your stick at this. You will soon acquire sufficient skill to score a hit fully half the time at a distance of from 40 to 60 yd.

And if you do miss, well, back it comes, like a trained eagle wheeling in the breeze!

boomerang will fairly zoom forward, spinning so rapidly that it is apparently transformed into a circular plate of wood of a diameter equal to a straight line joining the two ends.

That's all there is to it. The average beginner learns boomerang throwing somewhat like this: He pitches a few into the ground; he sails anywhere from two to thirty times with no visible signs of a return journey; and then—success, after which the knack is very seldom lost.

In a successful boomerang flight, the missile will swoop straight forward in a nearly vertical plane for a distance ranging all the way from 100 to 350 ft. As it covers this distance, it changes to an almost horizontal plane, and then, swerving to the left, it soars aloft like a bird and then comes swooping back in a long vol-plane, to land at the thrower's feet.

THE JAPS SAY . . .

"We shall always be able to mislead world public opinion."—Baron Giichi Tanaka, former Jap Premier.

AMERICANS SAY . . .

Are we going to let the little yellow so-and-so's mislead us? Not on your life! Buy more of those War Bonds and Stamps—buy till it hurts!



How To Make A

If you read the boomerang article on page 48 of this issue you're probably itching to try your hand at this great sport. Boomerangs are simple to make, and two interesting types are described here. Both are "marndwullen" or return boomerangs.

by Charles and
Bertram Brownold

Left: Using a cardboard pattern to lay out the boomerang on the wood. Pattern is held in place with thumbtacks.

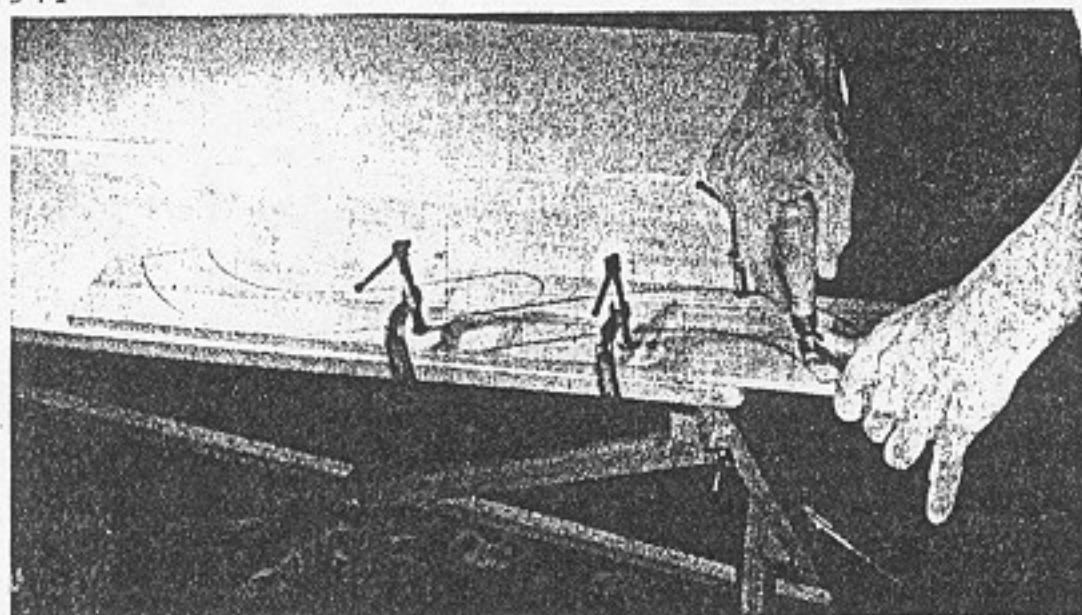
Mechanix Illustrated November, 1941

THE boomerangs built by the Australian bushmen vary in size, shape and weight, depending on the use for which they are intended. Different patterns are favored by the tribes in various parts of the country, and the fortuitous growth of the wood usually governs the type that the savage happens to select. The result is that there is no "standard" boomerang. Light boomerangs for knocking down birds and small game are sometimes only 18 inches in a straight line from tip to tip. At the other extreme are weapons of warfare more than four feet long and weighing over twenty pounds.

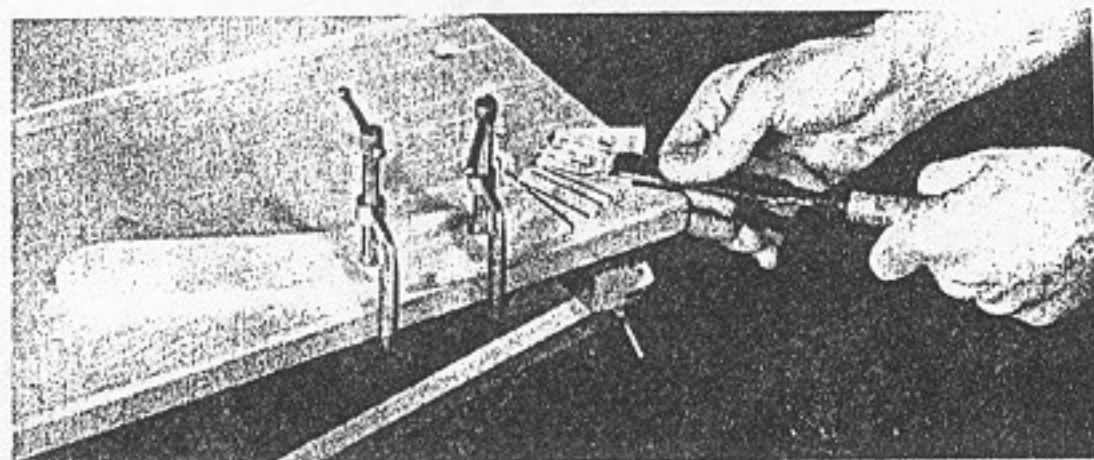
The shape varies as much as the size. Some are almost straight and others are bent nearly like a horseshoe.

The beautiful, curved flight of the boomerang, and its graceful, gliding return, make boomerang throwing a fascinating sport. A study of the scientific principles that control its flight has made it possible to present a plan for making with very little effort a boomerang that will perform in a manner that the primitive bushmen could only have achieved after generations of patient trial and error.

Make a pattern of stiff cardboard shaped as shown in Fig. 1, of drawings. This repre-



The two arms are cut out with a coping saw (above). Half lap joint is then cut with a chisel after saw has divided up the wood to be removed.



sents one arm of the boomerang. Using the pattern as a guide, lay out two such arms on a piece of hardwood $\frac{3}{8}$ " thick. The harder and heavier the wood, the better. Hickory, ash and maple are good. Soft wood will not stand the rough usage to which the boomerang will be subjected, nor will it be heavy enough for throwing.

Boomerang

The next step is to blank out the two arms with a coping saw or jig saw. Join the arms with a half lap joint cut as indicated by the line C, D. on Fig. 1, and as further shown on Fig. 2.

Next, with a plane, spokeshave and sandpaper, taper the thickness of the wood and round the edges so that when the two parts of the joint are together, a cross section at Point B on Fig. 1 would appear as shown in Cross Section B; while a cross section at Point A would appear as shown in Cross Section A.

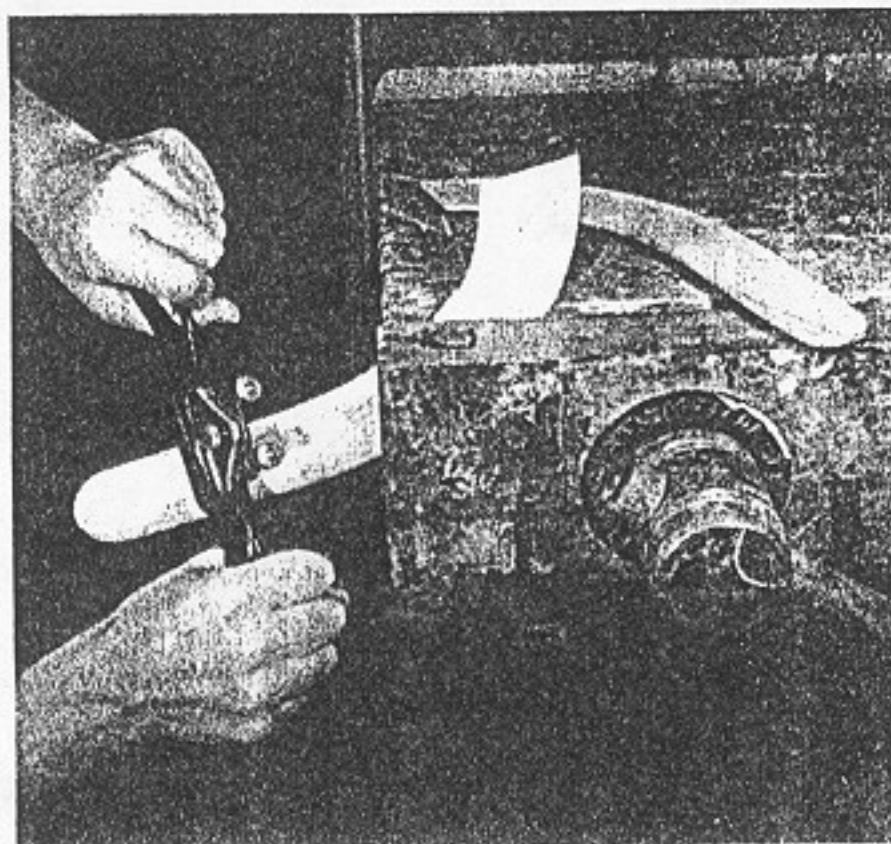
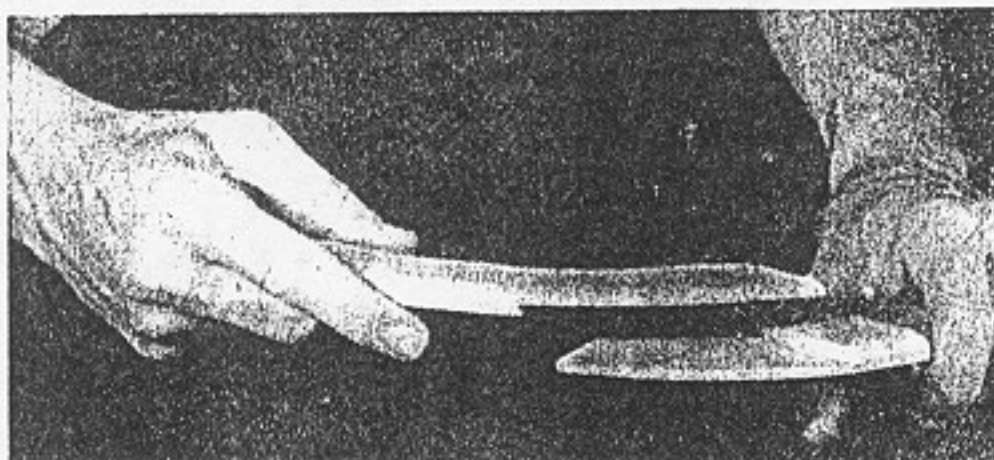
After both arms are shaped and sanded, glue them together under pressure. There is ample gluing surface so that the boomerang will be as strong at the joint as at any other point, if not stronger. One photo shows the joint glued up in clamps, with two blocks protecting the work from marks.

Before using the boomerang it is well to paint it some vivid color, or to paint black and white stripes on it so that it will not be too hard to find if it lands far from where the amateur "bushman" intended it to go on his first few practice throws. Plenty of open ground is needed, and it is inadvisable to catch the boomerang on its return with the bare hand, for the whirling arms can deal a painful blow. A net or basket can be used.

There is considerable difference of opinion as to the manner in which a boomerang should be thrown. Some authorities say that it should be held perpendicular to the ground and thrown with an overhand motion, while others say that it should be held parallel to the ground and thrown with a side-arm motion. Still others maintain that the best way is to try both positions as well as all the positions in between so that at last the best way will be learned. It is with the last-mentioned system that the present writer finds himself in agreement, for no two boomerangs will perform in an identical manner; nor will any one boomerang perform in the same way under different wind conditions. On



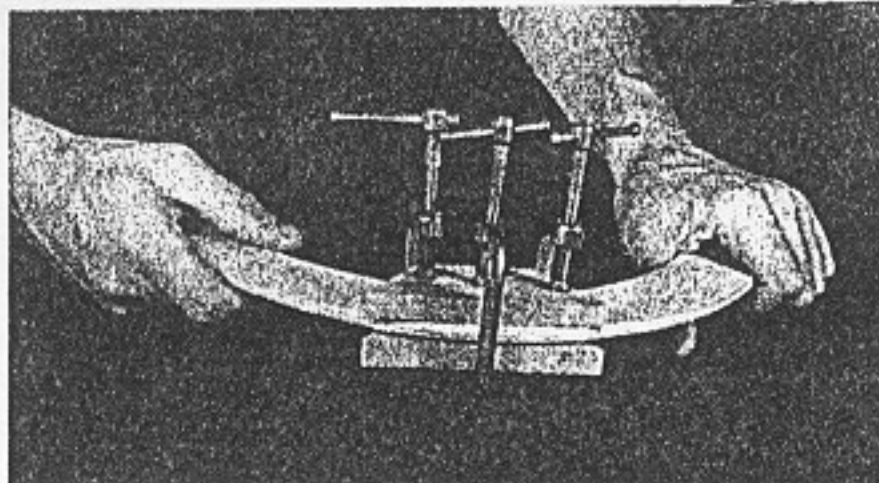
Above: Finished curved and cross-stick boomerangs. Striping makes it easier to find boomerang if a bad throw fails to return. Below: Both parts of half lap joint ready for assembly.



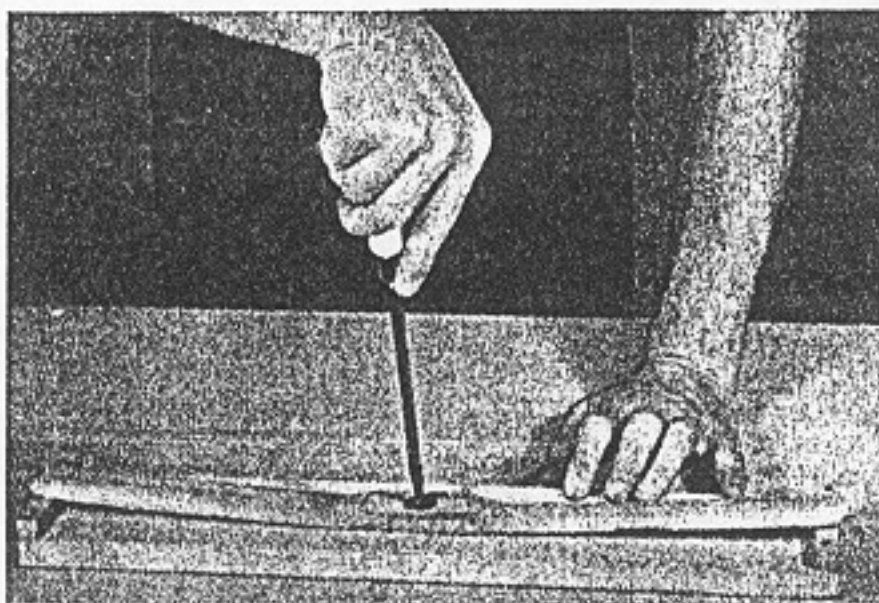
Right: Tapering and shaping one of the arms with a spokeshave.



Throwing the cross-stick. A side arm motion is used and the cross-stick is caused to spin by means of a wrist snap as it leaves the hand.



Glued-up joint under pressure is shown above. Blocks protect wood from clamps. Below: One arm of the cross-stick job is bending jig after boiling. Ends are blocked up half an inch.



one point, however, all authorities agree: Throw into the wind. For the boomerang has yet to be made that will return against the wind, no matter how skillfully thrown. And there is usually some wind.

The course of the boomerang in the air is always sensational for those who see it for the first time, and with a little practice it can be made to return to a spot near the thrower. Two factors have a bearing on its seemingly miraculous flight. The first is that because it

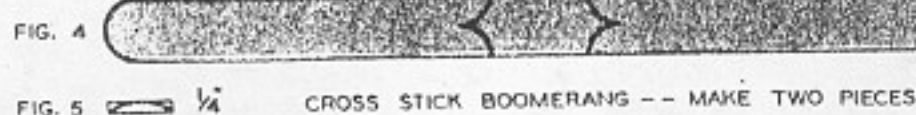
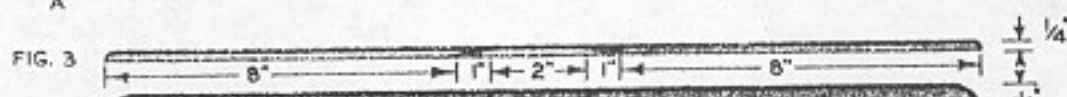
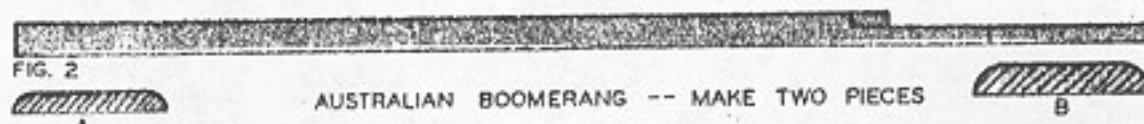
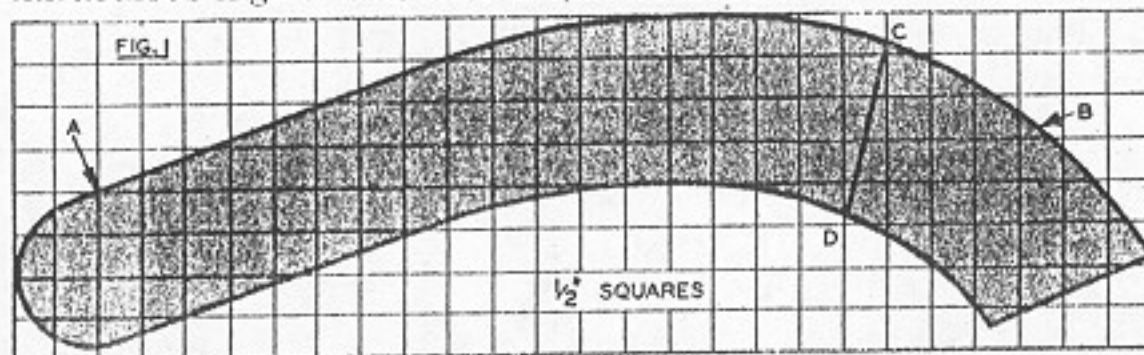
is spinning, it is, in effect, a circular disk in the air. The other is that, unlike a real circular disk, its weightiest part is far off center.

Four-Armed or Cross-Stick Boomerang

Strictly speaking, this is not a true boomerang but it is a fascinating toy. Take two sticks, each 20" long by 1½" wide by ¼" thick. Any wood will do so long as it is free of knots and fairly well seasoned. Shape each stick

as shown in Figures 3, 4 and 5. A spokeshave and a piece of sand paper are the only tools needed.

Next, boil both pieces in the family wash-boiler. Keep them in actively boiling water for twenty minutes and then while they are still hot and wet fasten them to boards with a screw through the center and with both ends blocked up on half-inch blocks. Remove them after they are dry and it will be found that the bend is permanent. The



Use a hard, heavy wood for your boomerang. Make a cardboard pattern from sketch above before cutting any wood.

length of time needed for drying varies, so that it is best to leave them blocked up for 24 hours.

Then cross the sticks at right angles with the convex surface both facing the same way. The result is a cross that is slightly dished. A bolt and nut hold the sticks together, and glue and four nails keep them at right angles.

This cross, when thrown, can be made to describe a graceful, lazy circle in the air and will return to the hand of the sender. It should be thrown with a snap of the wrist as it leaves the hand so that a good spinning motion is imparted to it.

BOOMERANGS

SCIENCE AND MECHANICS FEBRUARY, 1949 By R. H. JENKINS

THE designing, constructing, and throwing of boomerangs makes an interesting subject for scientific study. Though they look simple, there is involved in their construction a nicely balanced airfoil similar to the one found in the wings of any standard air plane. Careful work, therefore, is involved in their design and construction if one wishes to make a success of the undertaking. They are not a toy but a highly scientific weapon demanding careful study and workmanship. A writer for the Encyclopedia Americana (Vol. 4, page 246 b) defines a boomerang as a "weapon peculiar to the Aboriginal natives of Australia." He also says: "All efforts of the most skilled mechanics to make the boomerang have failed." There's a challenge for you! It seems to me that what one person has made another can duplicate, and know the why besides, so here is your opportunity.

There were two types of boomerangs, the return and non-return. The non-return was used in game hunting and could be thrown for long distances in a straight line. The return was more novel and probably was the accidental outgrowth of the hunting non-return type. This article, however, will describe construction and use of the more novel return type.

A return boomerang is one constructed on the principle of the airfoil of a plane; this gives the boomerang its lifting power. The weapon is thrown in a vertical position with the foil or curved side toward the operator. The back of the boomerang is a flat surface with only two exceptions and those are skews or beveled off places at each end for

Fig. 1. Here's a right-handed cross-stick type boomerang.

Fig. 2. Right- or left-handed cross-stick design, showing the application of a dihedral angle.

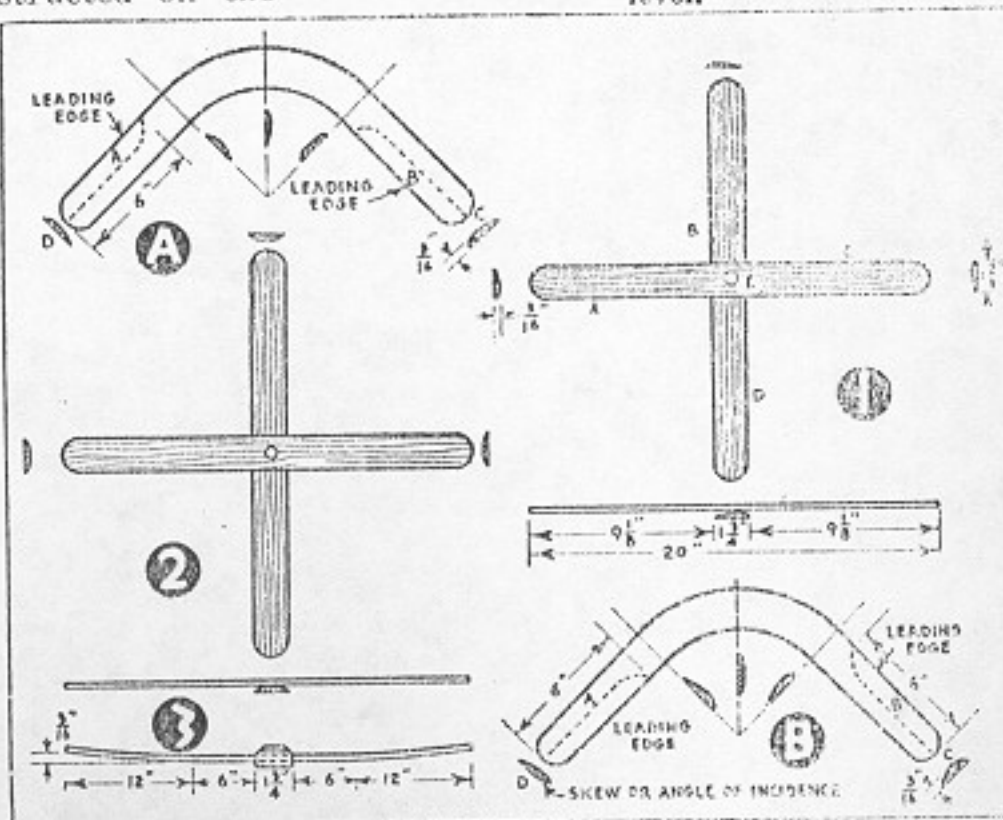
Fig. 3. Blades with dihedral angle.

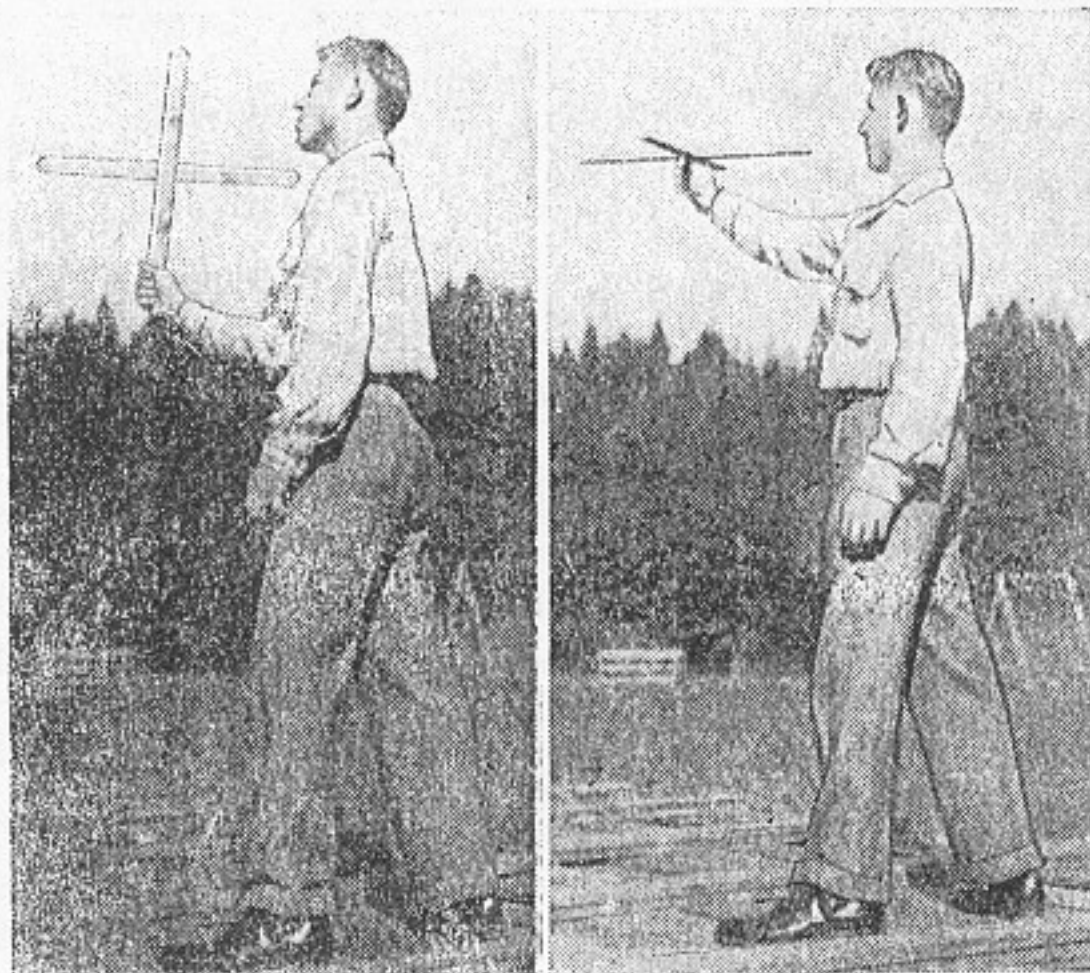
Fig. A-B. Sections and airfoil of a left-handed boomerang shown in A. Note leading edge is opposite that of right-handed plane. B shows right-handed boomerang with skew on leading edge and neutral territory only in middle.

How to design, construct and throw each of the various types



Grasped loosely in vertical position with curved side toward operator, boomerang is thrown out in straight line a little above eye level.

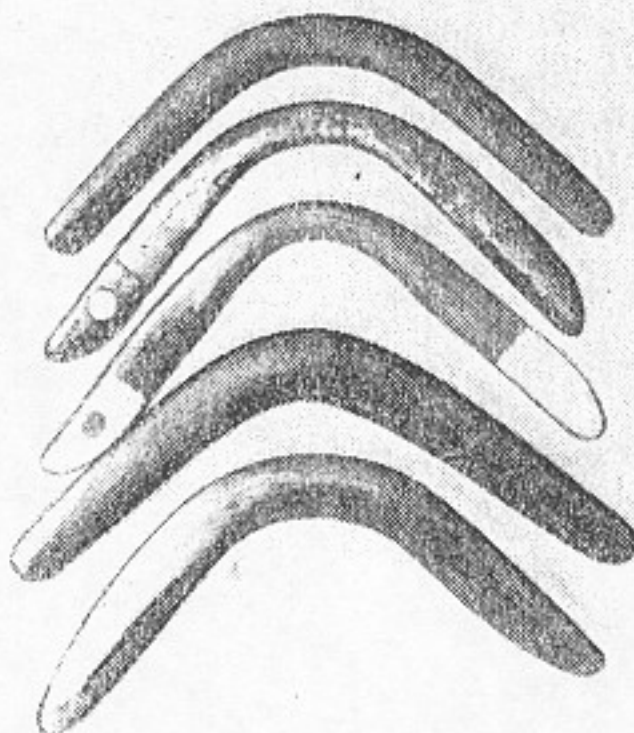




Note the vertical position of this cross-stick boomerang and remember that the curved side must be toward the operator.

As the cross-stick type boomerang floats down, it may easily be caught by the pin.

about five or six inches back and about half the width of the blade. These skews are on the opposite edges of each blade and are cut from the leading edge or thick part of the blade. These skewed places are called angles of incidence, and they are what cause the boomerang to return. As the blades cut the air the foil creates the lifting power so that the boomerang starts to level off in flight. At the same time the air striking against the skew starts the blade to turning. One thus has two forces at work, one a lifting force and the other a turning influence. The result is that the boomerang rises to some fifty or more feet, describes a large loop and comes back to the feet of the thrower. Of course it takes practice to get the best results. Remember to hold the boomerang vertically and throw with the curved side toward you. Though held in a vertical position the top of the boomerang is inclined away from the operator to about



Group of standard boomerangs.

ten degrees off from the vertical, this insures an accurate take-off and a nice return. Never throw a return boomerang in a horizontal position. When thrown correctly a boomerang will drift in to a perfect horizontal landing, but if thrown incorrectly it is almost certain to land on an end and break.

Throwing should be done on a quiet day free from wind. A field of soft earth or lawn is much preferred to hard ground as the boomerang strikes the ground hard when it lands. The thrower should face what wind there is and throw to the right of the main current of air. Grip the end of the boomerang lightly so as to give as much spin as possible and throw out on a line just a little above the level of the eyes. Throw moderately hard, at first and then harder as skill is attained. If thrown very hard the boomerang will make a complete loop and start out on a second round. If one wants the boomerang to land at one's feet it should be thrown moderately hard with plenty of spin and a tilt of about fifteen degrees of the top of the perpendicular. The extra tilt will make up for the loss of power in the easy throwing. However, each boomerang is a law unto itself, so it will take practice to master its use. Width and degree of skew will change the boomerang's travel. Some builders put more skew at one end than at the other for variety, and one of my friends makes an airfoil on both faces and claims it acts like a P-38 plane, tricky to handle but maneuverable.

You can try this interesting throwing game. Mark off a 20-ft. dia. circle and have the contestants throw to see which can get the first 10 landings in the circle. The contestants can stand anywhere that seems to their best advantage.

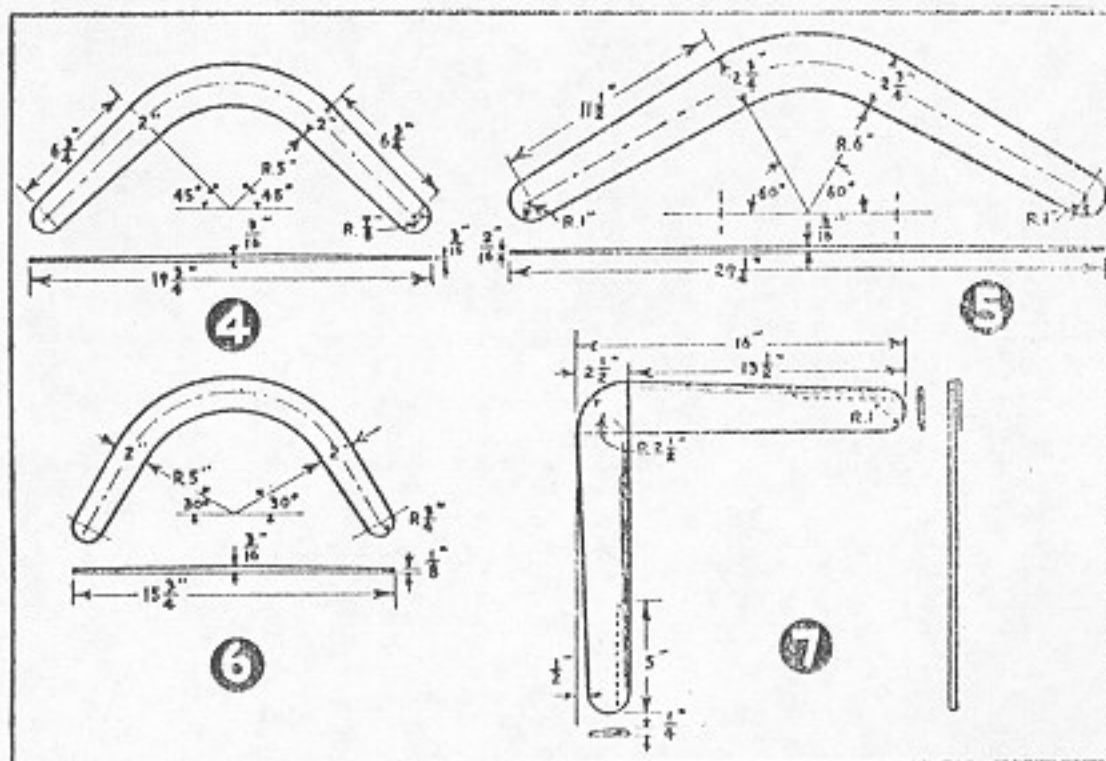
One of the simplest boomerangs to make in the beginning is of the cross-stick variety. Take a piece of soft wood 2 x 6 or 2 x 4 in., 20 in. long and rip up in strips approximately 3/16 in. thick. If the 2 x 4 in. has been surfaced it will be only about 1 3/4 in. thick in-

stead of the full two, so that the finished strips will be about $3/16 \times 1\frac{1}{4} \times 20$ in. Glue the pile of strips together as shown in Fig. 1. If a strong hot glue is used, clamps will not be needed. Do not cut out in a half lap joint but simply center and glue. When dry hold in the right hand in a vertical position as if preparing to throw and mark the leading edge as shown at A, B, C, and D. With a spoke shave or pocket knife form airfoil as shown in edge views. Sand the work and round ends to keep them from splintering. Bore a $\frac{1}{4}$ in. hole as shown at E, to hold a small pin about 4 in. long to catch the boomerang. This type comes floating down and can be caught successfully. A skew or angle of incidence is not needed with this type as they will return very quickly without that additional aid. This type also is strictly right- or left-handed depending on which edge is the leading edge.

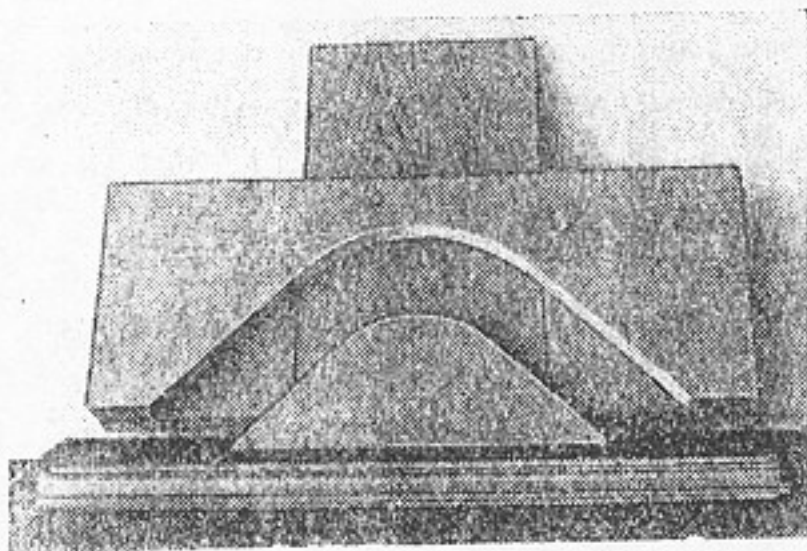
Next let's try the type similar to the first one, which is shown in Fig. 2. There are just two changes made here. The greatest thickness is in the middle making the air lift or airfoil from the middle out. This cuts down the wing span to half the width of the wing but makes the boomerang either right- or left-handed.

Figure 3 shows how blades can be given a dihedral angle, which stabilizes this type of boomerangs. Hold over a gas flame and heat curved edge, at the same time bending the wood toward the curved surface. Bend until the straight surface of the back is in line with top at the center. Bend each blade or wing the same, at a point about $\frac{2}{3}$ the distance from the ends. This dihedral angle can be seen in the wings of a flying buzzard; it gives stability to both the bird and the boomerang.

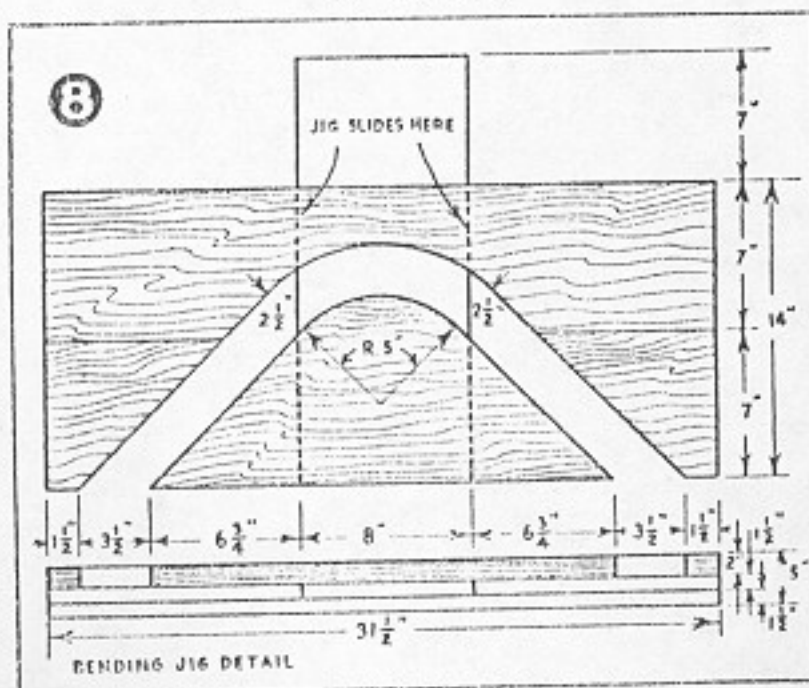
One of the first problems in making a regular return boomerang is to get the correct curve to the wood. This might be done by steaming, but steaming and bending of a piece of wood large enough for a boomerang is a rather difficult process and requires more equipment than the average shop possesses. So let's build up the curved piece to whatever size we need, using a laminating process. First lay out a bending jig out of 2-in. tough wood stock (Fig. 8). Lay out the curve desired for the boomerang wanted (Figs. 4, 5, 6). Unlike the finished boomerang, however, the sides of the jig must be parallel in order to make the press work. Plan the lay-out so that the laminated stock will be at least $2\frac{1}{2}$ in. wide or even wider, and make the middle section so

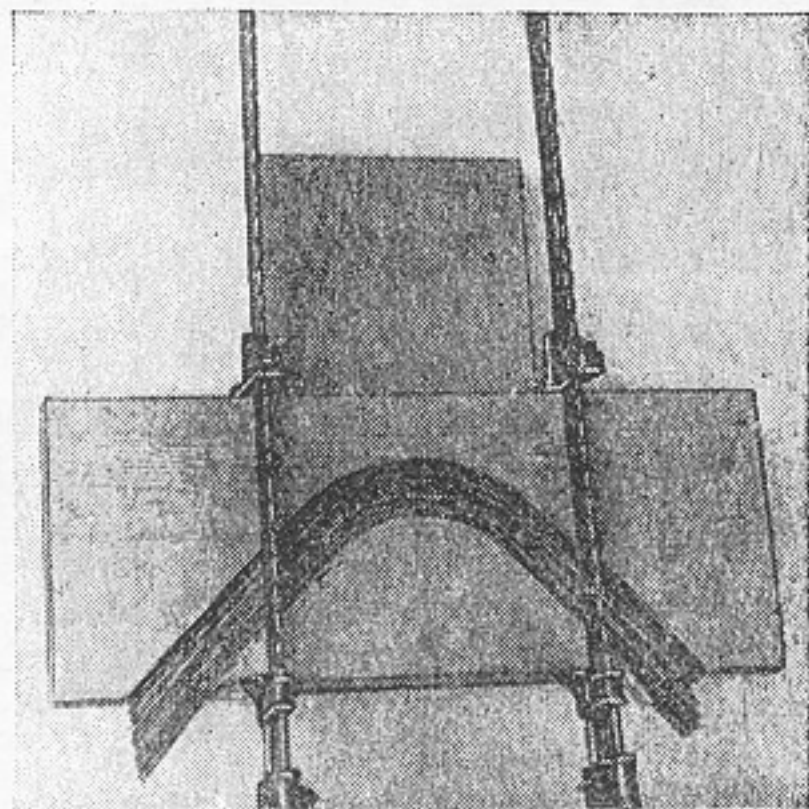


that it will slide. To use the jig, rip out strips of hard wood, oak or maple, $\frac{1}{8} \times 2 \times 30$ in. Cut about 20 strips. Use a good grade of waterproof glue and cover the surface of each strip. Glue all of the strips and then place the whole mass in the jig and apply the clamps. When dry this blank can be resawed into about four good boomerangs. Each resaw-



Boomerang jig with the strips laying in front ready for the glue.





Strips are clamped in the jig and ready for drying.

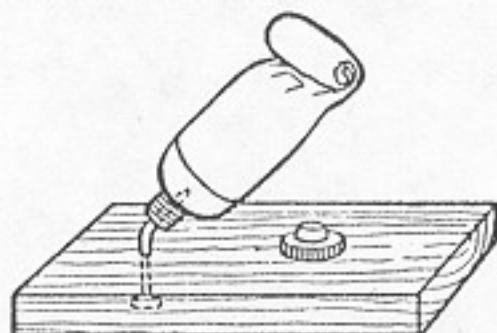
ing does not have to be over $\frac{3}{8}$ in. thick.

While waiting for glue to set and dry it might be well to try a rough boomerang (Fig. 7). This will not fly as smoothly but is a good type to practice on.

Cut a paper pattern following the design laid out on the jig. Mark out pattern on the blank and cut out on a scroll, band, or coping saw. With a spokeshave cut down to dimensions. Note that the left-handed boomerang is exactly opposite in design to the right. Make a good airfoil but cut down the whole piece until it is light enough to throw easily. A $\frac{1}{4}$ -in. in the middle is usually sufficient, with a slightly smaller amount at the ends. Don't forget the angle of incidence or skew. When the piece is pretty well roughed out, try it out and then keep trimming, until it works perfectly. Mark a little star on the end which you will hold. Sand carefully and apply a coat or two of good varnish. Bright colored paints look well, especially on the cross stick type. A particularly striking effect may be obtained by using luminous paint and throwing at night.

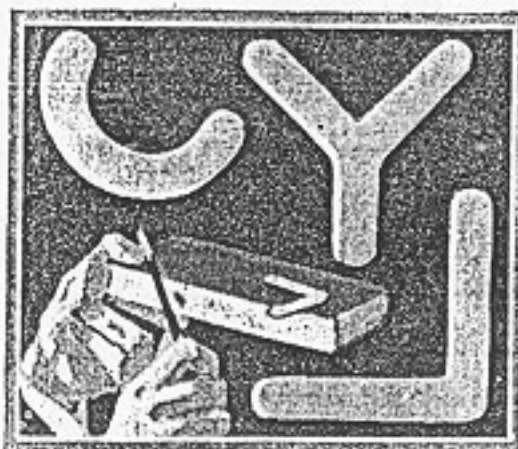
Craft Cement Always Ready for Use

● Craft workers don't have to remove and replace the cap on cement tubes each time if a small nail is driven at an angle through a section of thin board or plywood and the tube is impaled upon it. Nail should be large enough to fill tube opening, but, if not, cement will dry around it to reduce size of aperture.—G. E. H.



THE BOOMERANG

Upon a piece of cardboard about the thickness of a postcard draw any one of the three designs shown in the square at the left. Then with a sharp penknife cut out the design, taking care to leave no uneven or jagged edges. The ends must be smoothly rounded and the design perfect in proportions and cleanly cut. Other-



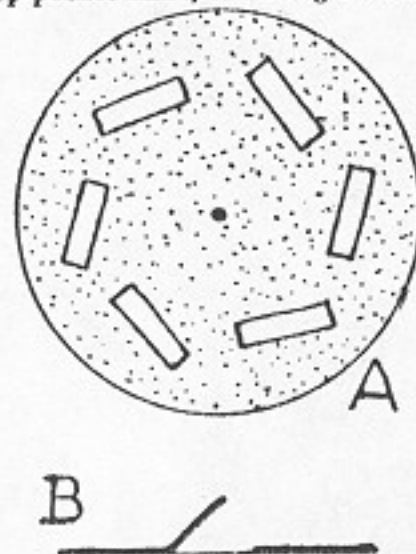
wise your boomerang will not come back to you when you throw it, as it is meant to do. Now lay the boomerang on some flat, smooth surface and send it off with a quick but even stroke of a lead pencil. If the boomerang does not make a graceful curve through the air and come back to you, it will be because your design is imperfect or your cardboard of the wrong thickness. Try making another till you get one that will work. Even

learned scientists do not quite understand why the boomerang comes back, but the fact that it will do so has been discovered by different savage tribes. It is said that the ancient Egyptians had found it out. The people most famous for their boomerangs are the natives of Australia, who use the invention as a weapon. An Australian boomerang is a sickle-shaped strip of wood two or three feet long.

A TOP THAT SPINS IN THE AIR

This is a very wonderful top because, unlike the ordinary ones, it will spin in the air. First procure a post card and cut out of it a circle two and a half inches in diameter. Be very careful that you do not buckle the card, because, if you do, it will catch the wind at the wrong angle when it is spun, and fall to the ground.

Next draw about six rectangles on the circle in the positions shown in Diagram A. Note that they do not follow each other round the circle in a ring; but each is set at an angle which you must imitate fairly closely. Then, with a sharp pocket-knife, cut along all the edges of each



rectangle, except the one nearest to the circumference, and bend up the rectangles so that they form little flaps. The second diagram shows how much they should be bent.

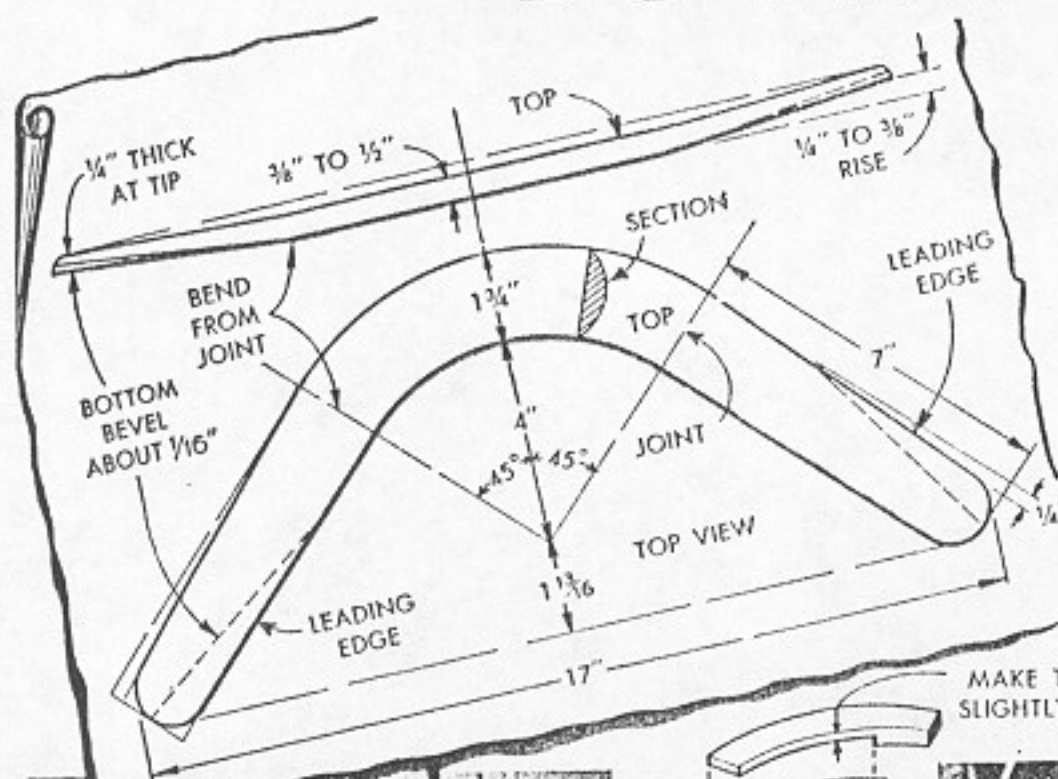
When this is done, push a pin through the centre of the circle in such a way that the pin-head is underneath and so that no more than three-quarters of the body of the pin appears above.

It must be pushed through absolutely vertically, so to keep it upright, cut a little circle of stamp paper, lick it, and push it over the pin-point and stick it on to the card.

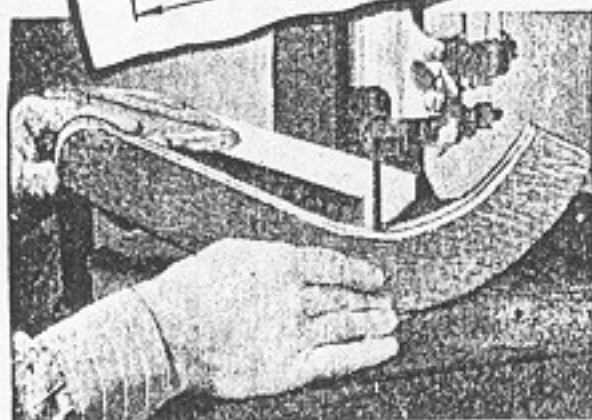
Now take something that you can blow through, such as a pea-shooter, a cigarette holder, or any piece of piping. Hold the tube—whatever it is—upright and put the toy-top just under the lower end, keeping it there with the finger-tip. As you blow down the tube, the top begins to revolve and, in a second, you can take away your finger; but the top will go on spinning gaily. It will continue to do so as long as you have breath to blow.

If you cannot get the top to go properly, it is probably because the pin is not quite vertical, the circle is bent or the card is too thick and heavy.

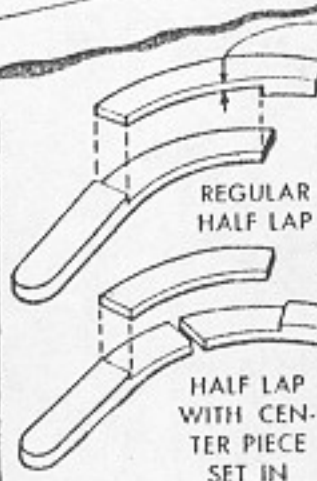
BOOMERANGS



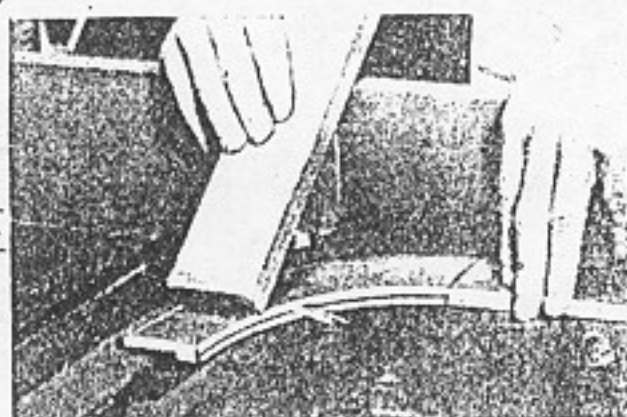
When made and thrown correctly, boomerangs will describe a loop in the air and return to the thrower. Oak, maple or other tough wood is best to use. Laminated construction (several thin pieces glued up to provide the required thickness) is best because of less tendency to warp. However, you can use solid stock $\frac{3}{8}$ in. thick. In either case, band-saw a piece to a size and shape to represent one half of the completed boomerang. Then rip this piece in half to produce two identical pieces. Glue these to-



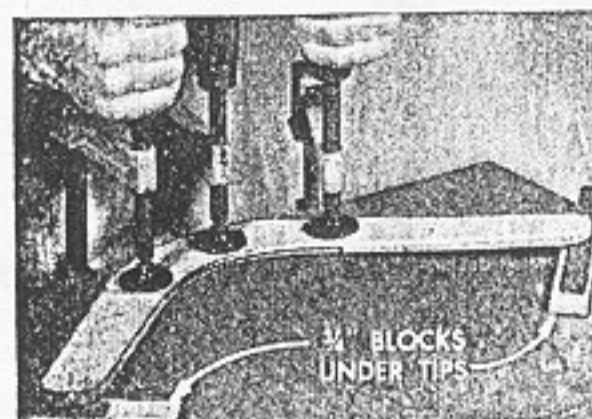
Cut outlined shape from $\frac{3}{8}$ -in. stock, then rip to get two identical pieces



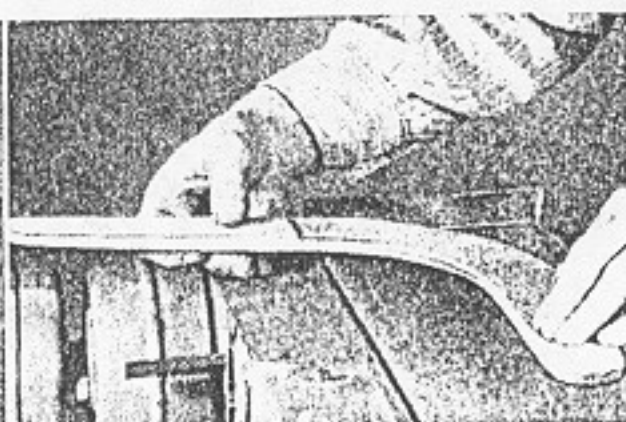
MAKE TOP HALF SLIGHTLY THICKER



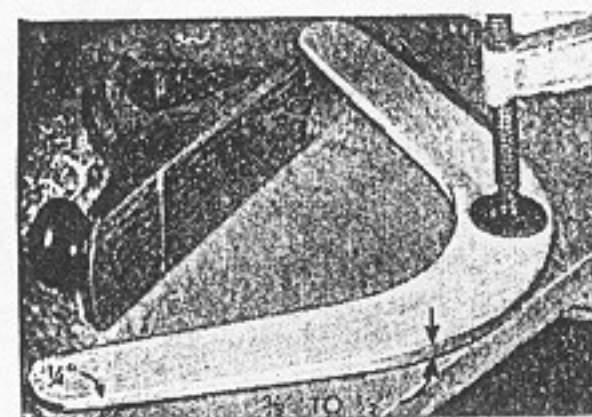
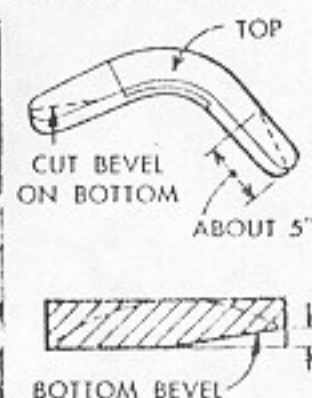
Cut a half-lap joint with a dado head or straight molding cutter. Leave the top lap a little thicker than the bottom



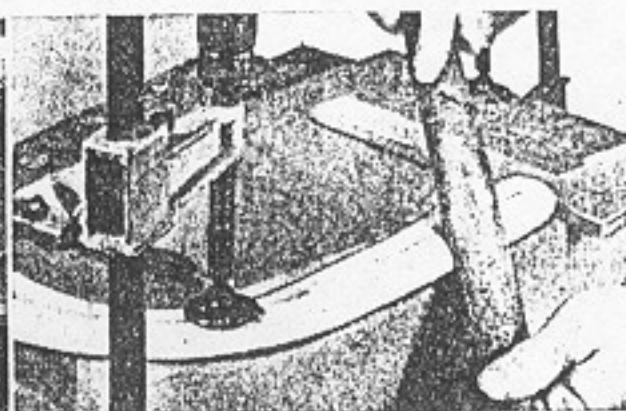
Glue the joint. Spring the tips upward on blocks to get required rise



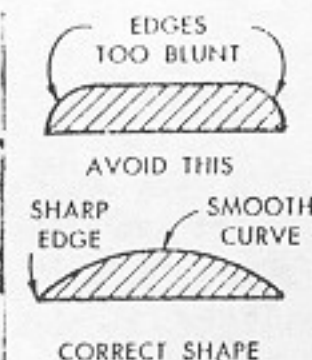
Sand or plane the bottom bevel—about $\frac{1}{16}$ in. probably will be enough. You can increase it later if it is necessary

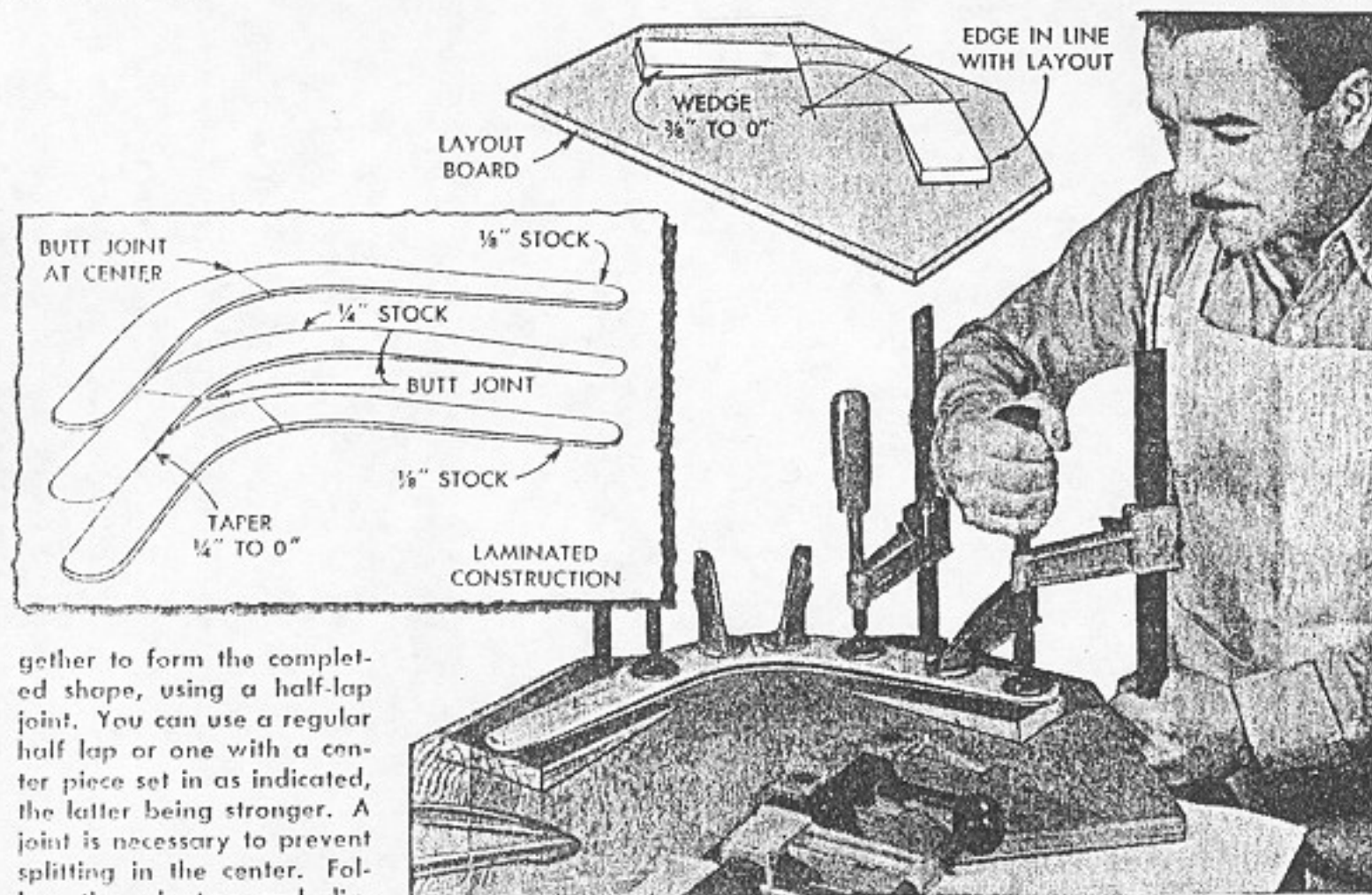


Plane the top surface from joint to tip



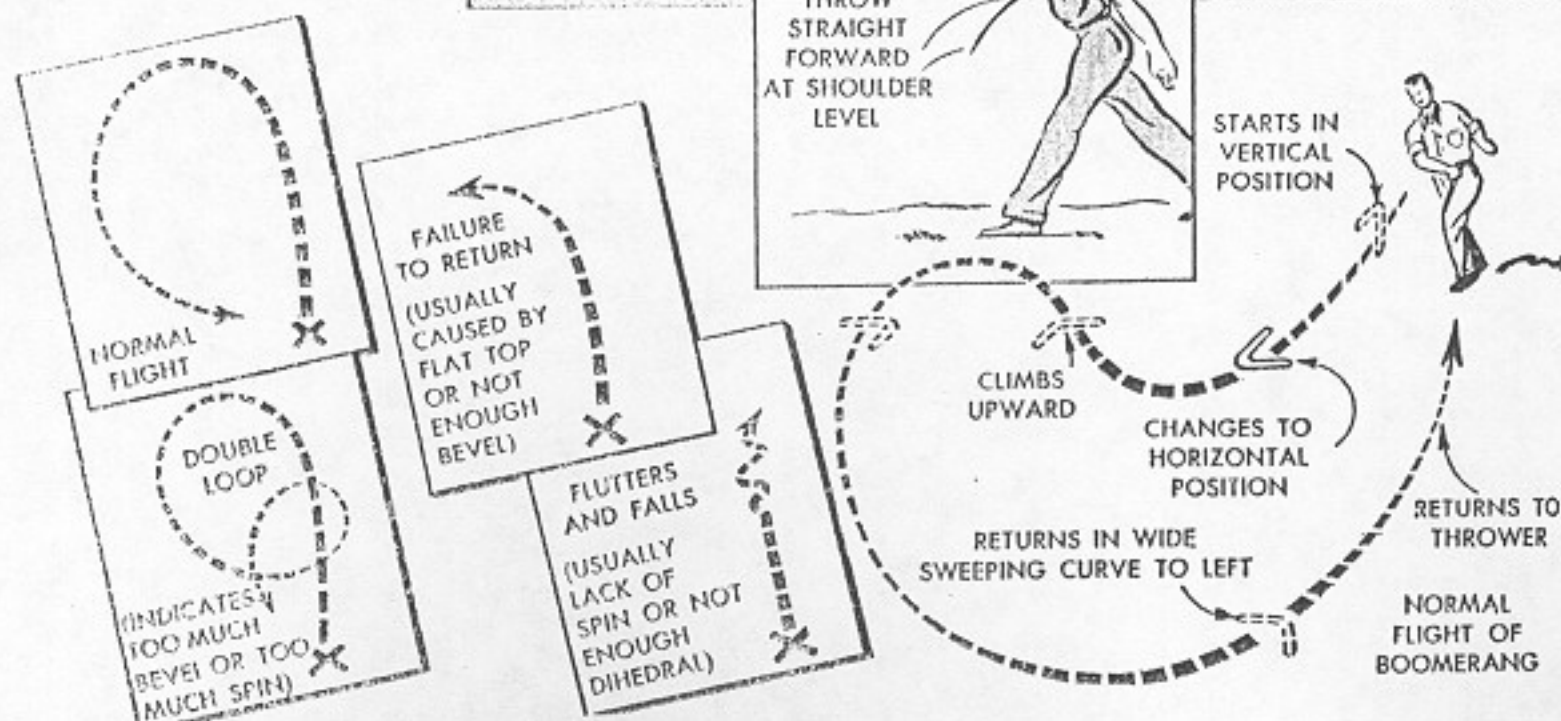
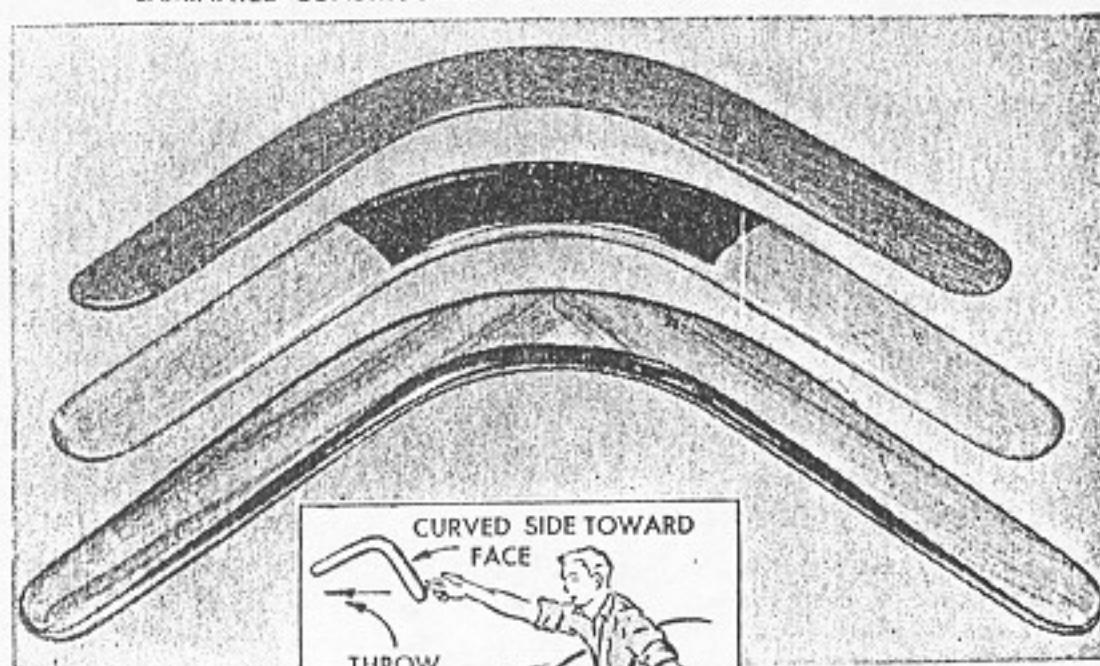
Round the top surface with a wood rasp and sand smooth





gether to form the completed shape, using a half-lap joint. You can use a regular half lap or one with a center piece set in as indicated, the latter being stronger. A joint is necessary to prevent splitting in the center. Follow the photos and diagrams in gluing up the joint. The top surface is rounded and the bottom is flat except at the tips where it is beveled. If you throw left-handed, bevel the corners opposite those indicated. Normal flight is shown below. The diagrams also show some of the results of faulty construction and how to correct them. In throwing, use plenty of wrist action for a fast spin, yet not too much, as indicated in the lower left hand diagram. Test the boomerang on a calm day as it is erratic in a breeze.

LAMINATED CONSTRUCTION IS STRONG AND HOLDS ITS SHAPE

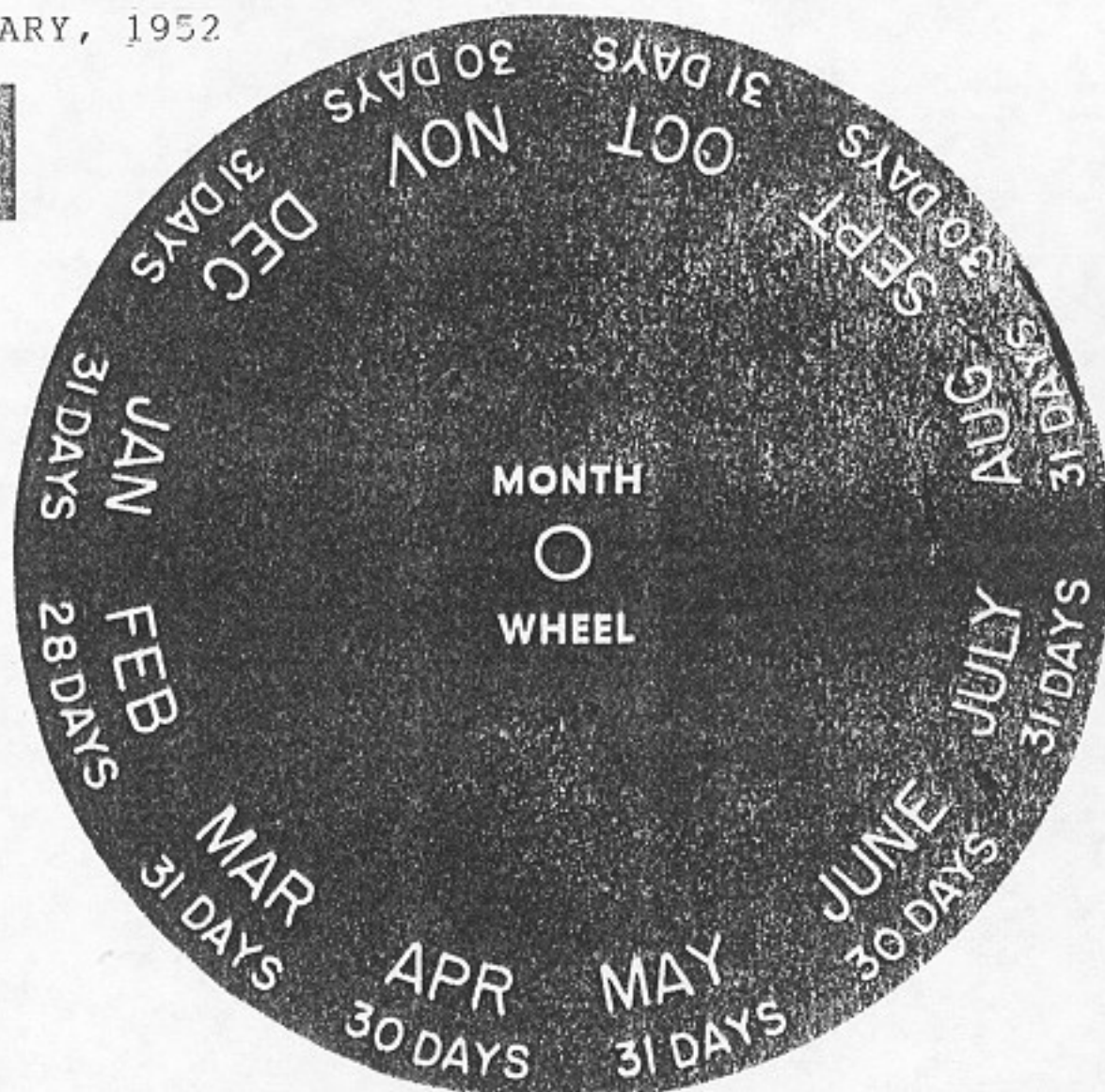


MECHANICS ILLUSTRATED FEBRUARY, 1952



DAY STRIP

cut out day strip,
month wheel, and
date strip and
secure to cardboard
with cement or glue



DATE STRIP

						1	2	3	4	5	6	7
2	3	4	5	6	7	8	9	10	11	12	13	14
9	10	11	12	13	14	15	16	17	18	19	20	21
16	17	18	19	20	21	22	23	24	25	26	27	28
23	24	25	26	27	28	29	30	31				
30	31											

1/2" SQ. X 6 5/8" SIDE FRAMES
CUT OUT 1/4" DADO

1/2" SQ. X 5 3/4" TOP AND
BOTTOM FRAMES - CUT
OUT 1/4" DADO

5" X 7" GLASS
PLATE

CARDBOARD
NO. 2

CARDBOARD
NO. 1

CUT OUT
FINGER
HOLE

5" X 7"
CARDBOARD

DATE STRIP

CUT OUT
SLOT

PICTURE
OPENING
4" X 4 1/2"

MONTH-WHEEL
OPENING

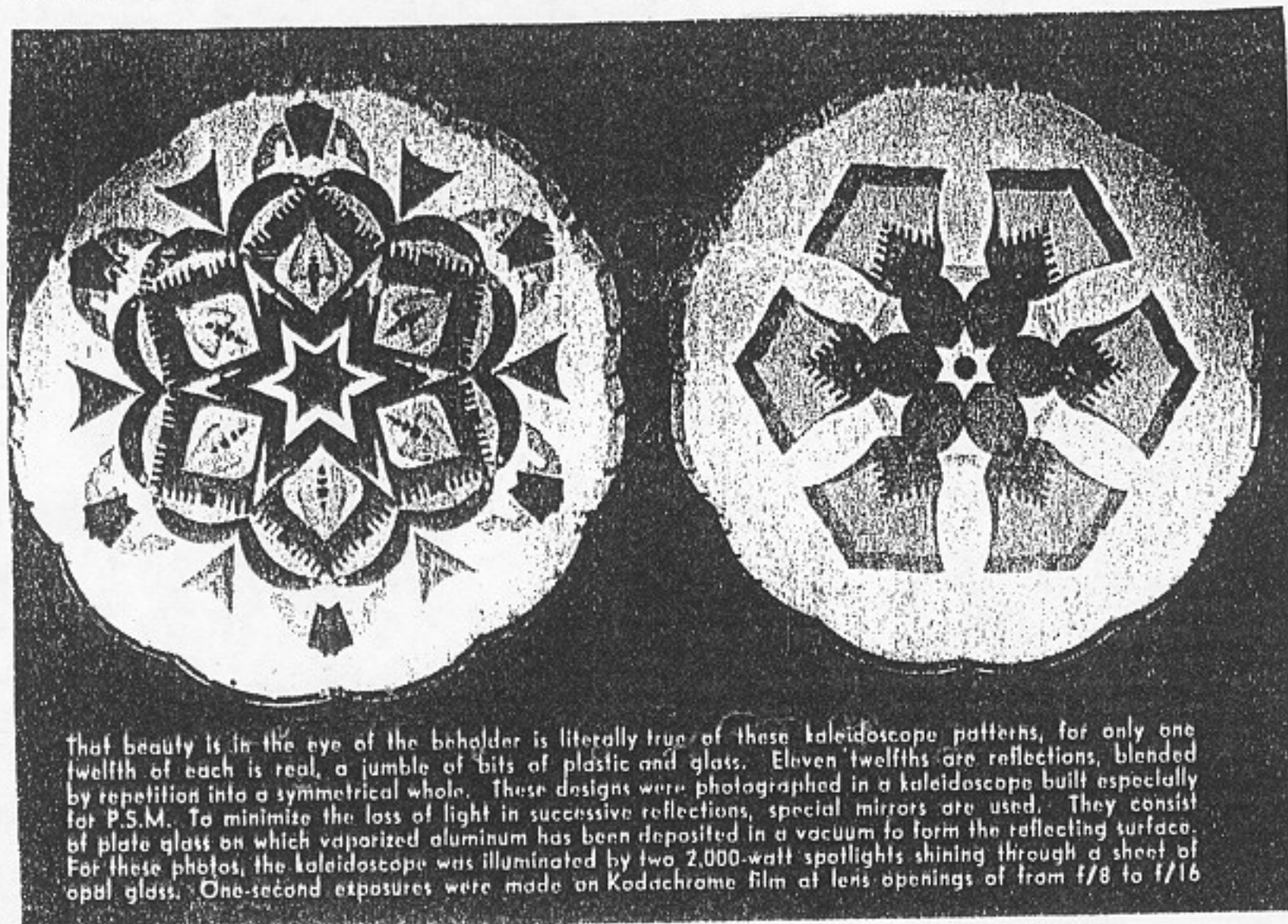
1 1/2" X 1 3/4"
OPENING

TIME TAKES ALL
BUT MEMORIES

3/4" X 1 1/8" X 7"

1/4" PLYWOOD

Perpetual Calendar. This ingenious desk accessory features a rotating month wheel and a sliding date strip. Cut out the month wheel, date strip, and day strip that appear on this page and mount them on cardboard. Prepare a plywood face and a 5x7-in. cardboard backing piece in which the two lower holes in the face are duplicated. Glue the day strip to the back of the cardboard and glue a picture on the face. Pin the month wheel to another 5x7-in. piece of cardboard so the months show properly through the opening in the first piece. Insert the date strip and, as shown, add a piece of glass, a rabbeted frame, a base, and, if desired, a motto. Holes in the back piece of cardboard allow the month wheel and date strip to be moved. *



That beauty is in the eye of the beholder is literally true of these kaleidoscope patterns, for only one twelfth of each is real, a jumble of bits of plastic and glass. Eleven twelfths are reflections, blended by repetition into a symmetrical whole. These designs were photographed in a kaleidoscope built especially for P.S.M. To minimize the loss of light in successive reflections, special mirrors are used. They consist of plate glass on which vaporized aluminum has been deposited in a vacuum to form the reflecting surface. For these photos, the kaleidoscope was illuminated by two 2,000-watt spotlights shining through a sheet of opal glass. One-second exposures were made on Kodachrome film at lens openings of from $f/8$ to $f/16$.

POPULAR SCIENCE
OCTOBER, 1944

Our Camera Takes a Look

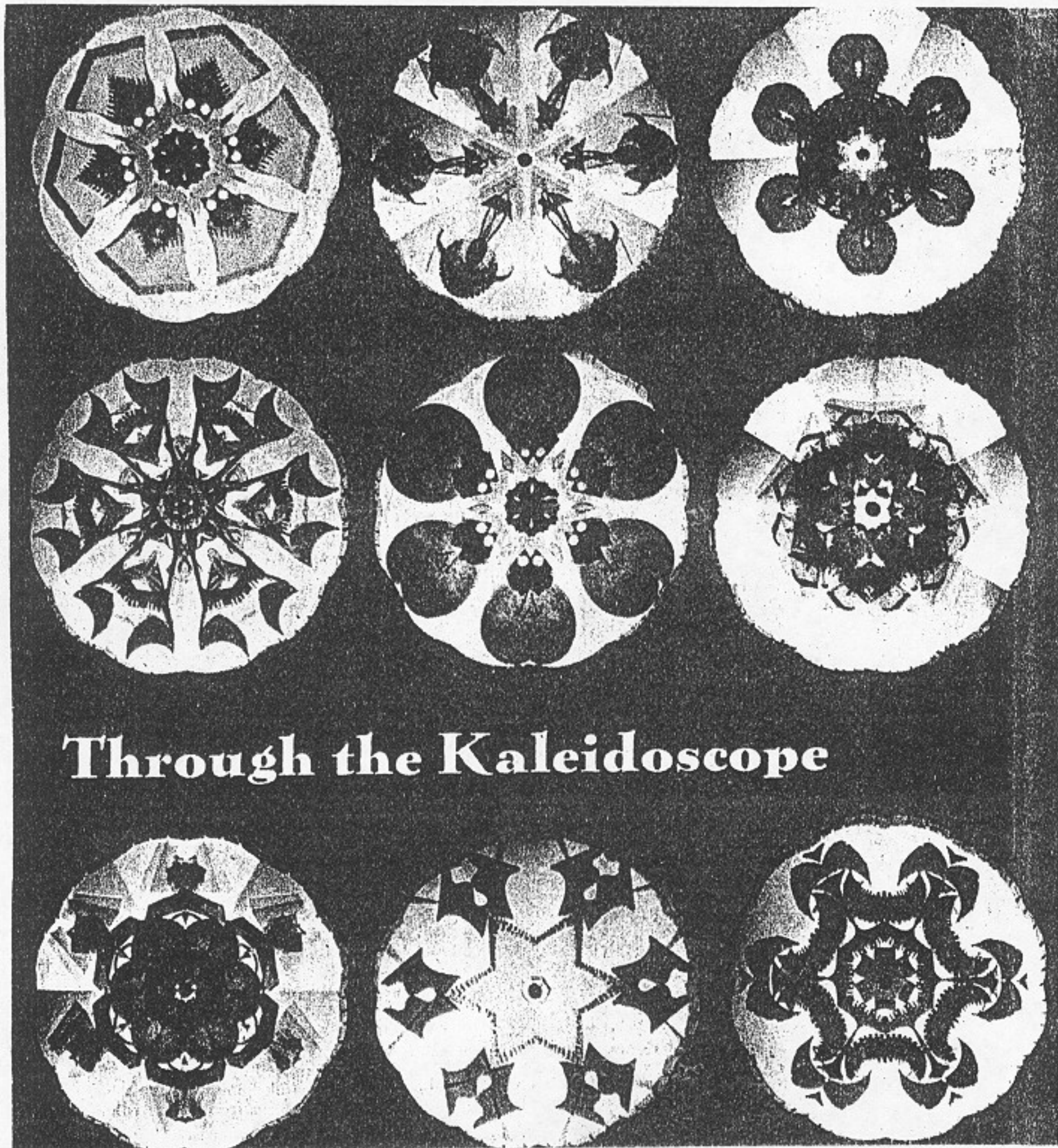
By HARRY WALTON

Photographs by WILLIAM MORRIS
and ROBERT SMITH



VISITORS to London about 1816 were amazed to see people in the streets gazing skyward through pasteboard tubes. But these watchers were peering at no eclipse or comet. They were fascinated by a scientific novelty that had taken London by storm—the kaleidoscope, invented by Sir David Brewster. First regarded only as a toy, it was soon adopted by artists as an aid in originating new designs. Sir David named his invention by combining three Greek words: *kalos*, meaning beautiful; *eidōs*, form; and *skopeo*, I see. Almost anyone who has looked through a kaleidoscope will agree that the name is appropriate.

Two mirrors on facing walls create the familiar illusion of an endless succession of walls. Multiple reflection also produces the pat-



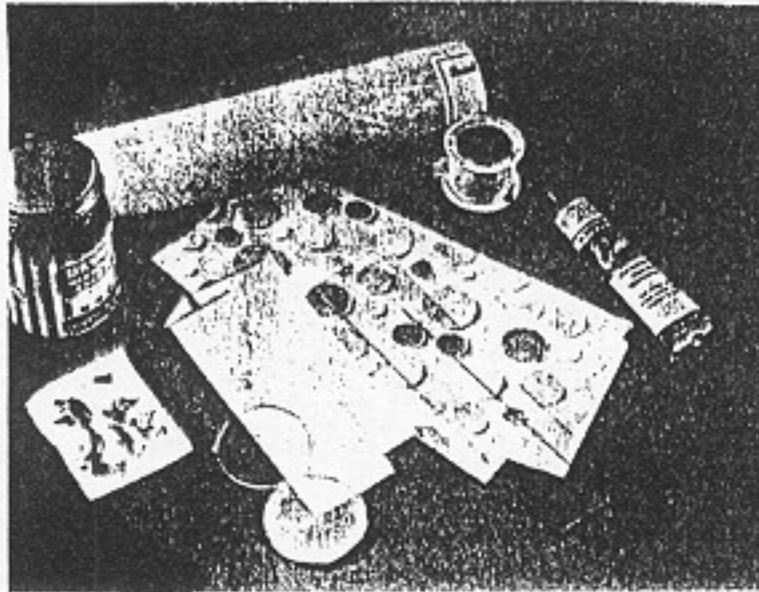
Through the Kaleidoscope

terns in a kaleidoscope, but the mirrors are joined at one edge, so that the reflections form a circle. Their number depends upon the angle between the mirrors.

Because of the angle at which reflection occurs in a kaleidoscope, ordinary mirrors will produce a blurred double image—both the silver backing and the glass surface reflect light. The mirrors must be of the front-surface type. Unsilvered glass acts as such a mirror, particularly if its back

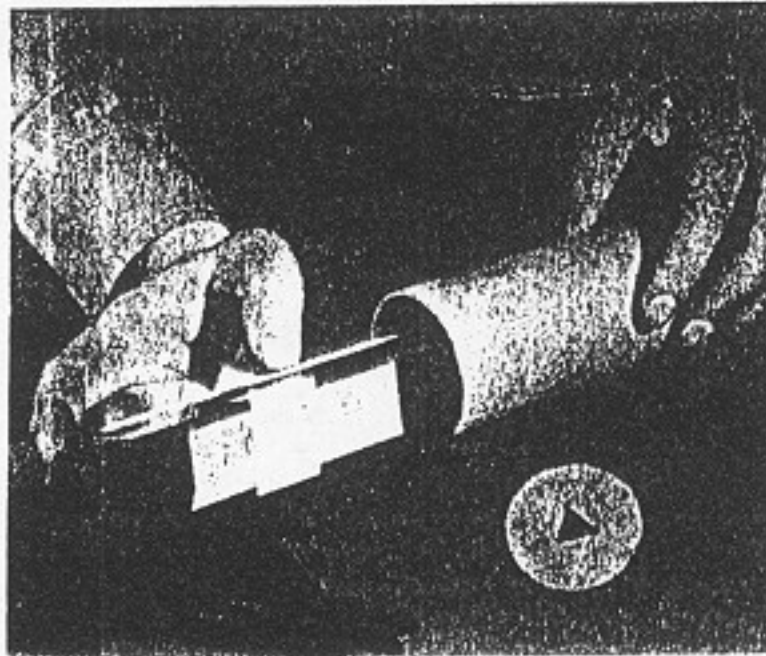
surface is blackened with paint or enamel.

Small kaleidoscopes can be bought at toy counters, but you can assemble one from common materials, and learn much about this fascinating device. Pictures on the following pages show step by step how to build a two-mirror kaleidoscope that will form twelve-unit patterns similar to those above. Three mirrors of the same size arranged triangle fashion will form six-unit designs and multiply each into an all-over pattern.

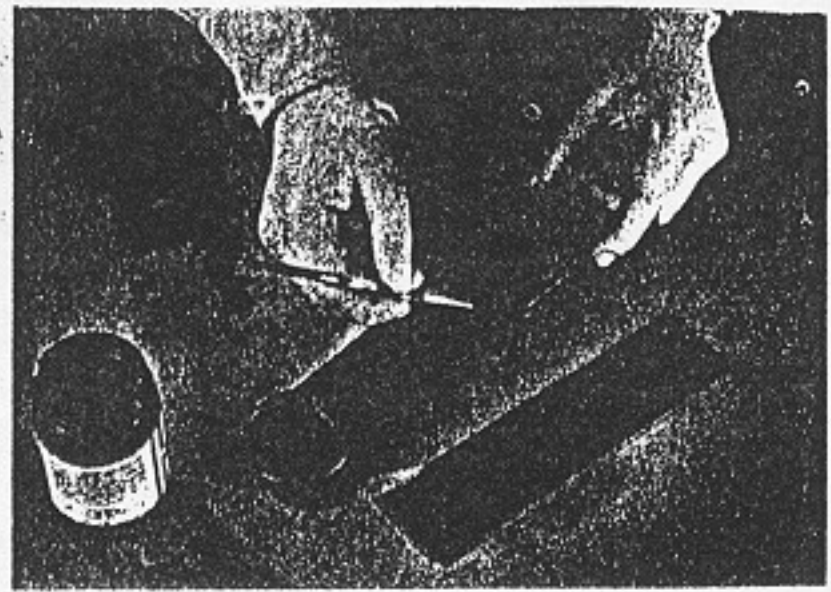
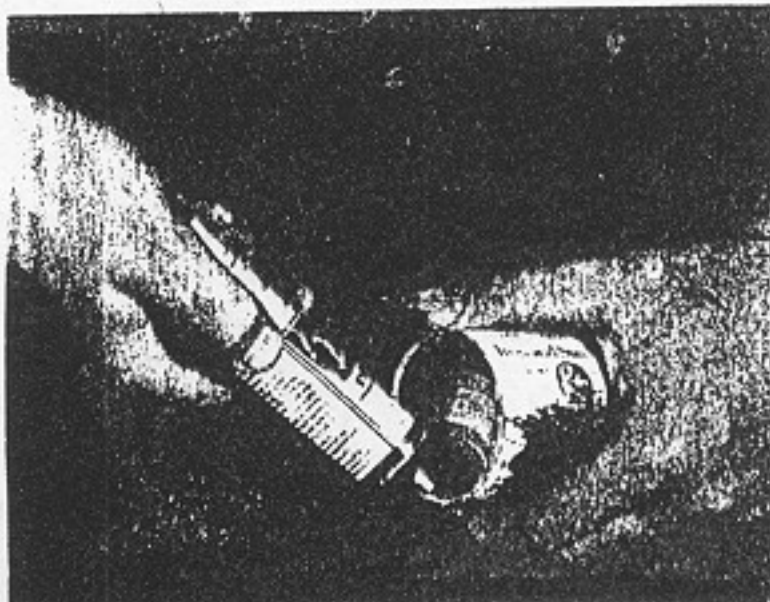


1 The kaleidoscope on page 110 was made from these parts: a 2" by 9" mailing tube, two glass strips $1\frac{1}{8}$ " by 8", a frosted and a clear glass disk, black paint, tape, cement, cardboard, plastic scraps, and covering paper

5 Tape the spacing strip in place to hold the mirrors 30 deg. apart. Be sure the painted surfaces are outside; then slide the mirrors into the tube as in the photo below. If they fit loosely, wrap a sheet of paper about them

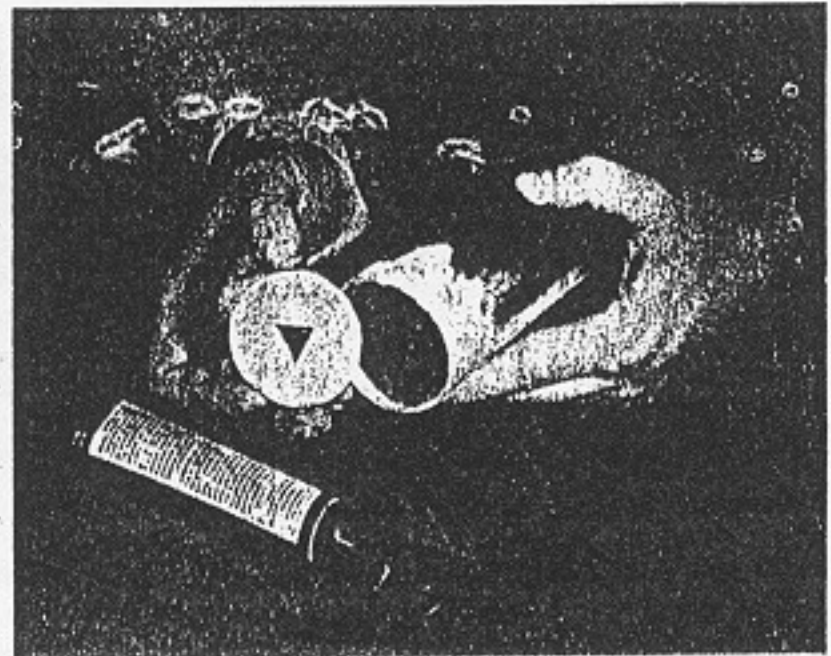


9 It is interesting to experiment by varying the amount of the load and using scraps of different colors. To view the patterns, press the frosted disk into place. When the load is satisfactory, secure the disk by cementing it

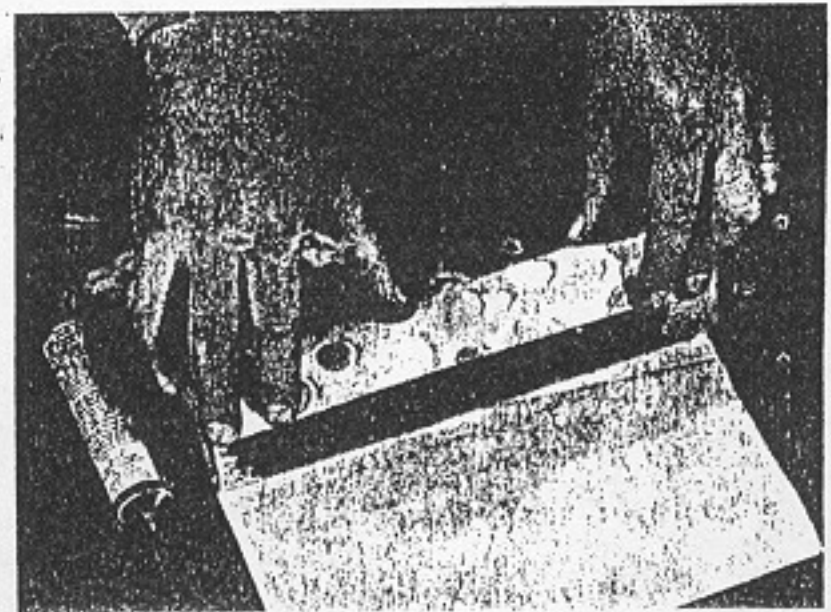


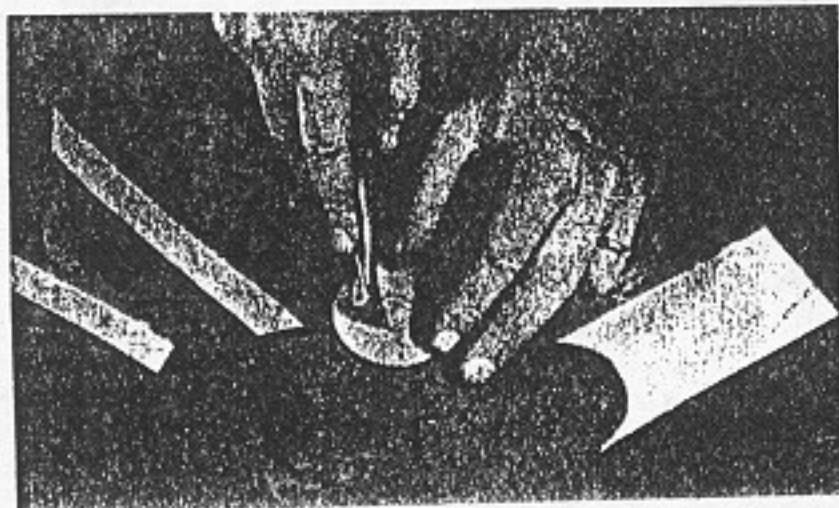
2 Sizes are not critical if correct proportions are maintained. Any tube can be used, provided the glass strips are cut to fit inside at an angle of 30 deg. They should be about four times as long as they are wide. Coat one side of each with black paint or enamel

6 Push the mirrors $\frac{1}{8}$ " inside the end of the tube. So placed, they should reach to within about $\frac{7}{8}$ " of the other end. This will leave ample room for the load. Apply cement thinly inside the $\frac{1}{8}$ " space and to the edge of the eyepiece, and press this into place



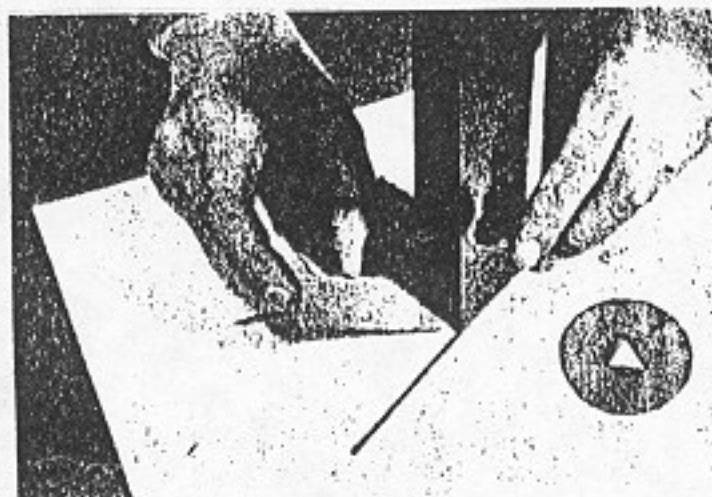
10 You can improve the outward appearance of your kaleidoscope by wrapping the tube in some gaily colored decorative paper. The kind used for Christmas packages is ideal. Clear model-airplane dope, lacquer, or varnish will prevent injury from frequent handling





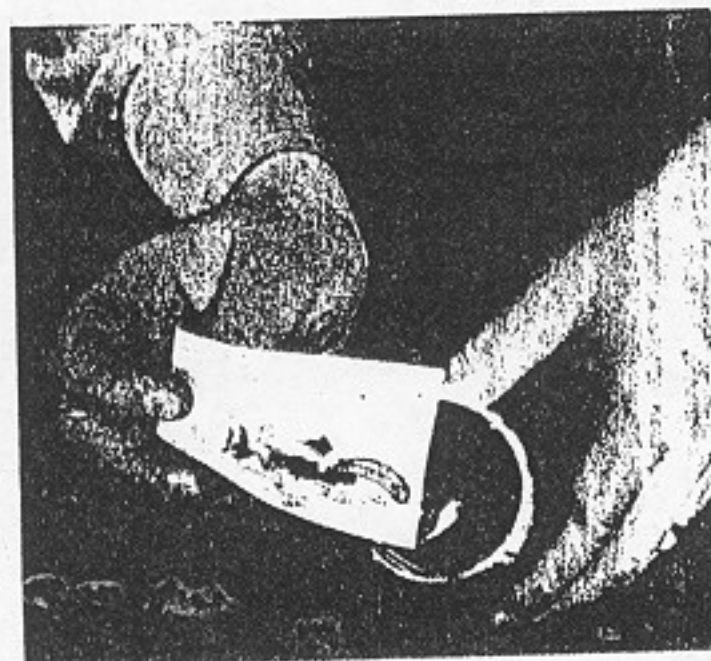
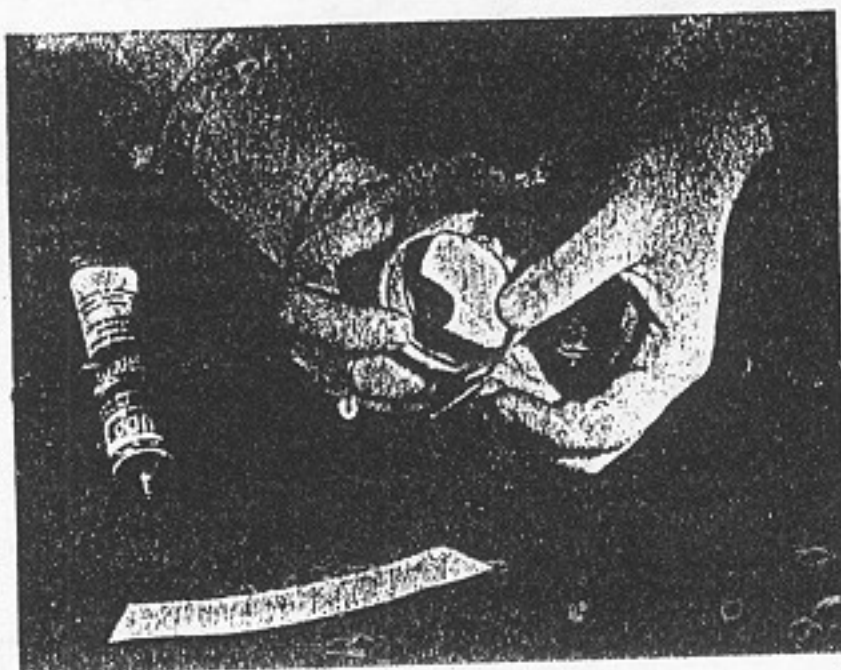
3 While the painted glass is drying, cut a disk out of stiff cardboard, making it a close fit inside one end of the tube. At the center punch a $\frac{1}{4}$ " peep-hole. If no punch is available, use a sharp knife to cut a triangular hole $\frac{3}{8}$ " on a side, as shown above

7 Turn the tube around and push the clear glass disk into it right against the ends of the mirrors. A little cement may be spread around the edge. Now cut a cardboard strip $\frac{5}{8}$ " wide and long enough to overlap inside the tube. Cement it fast as in the photo

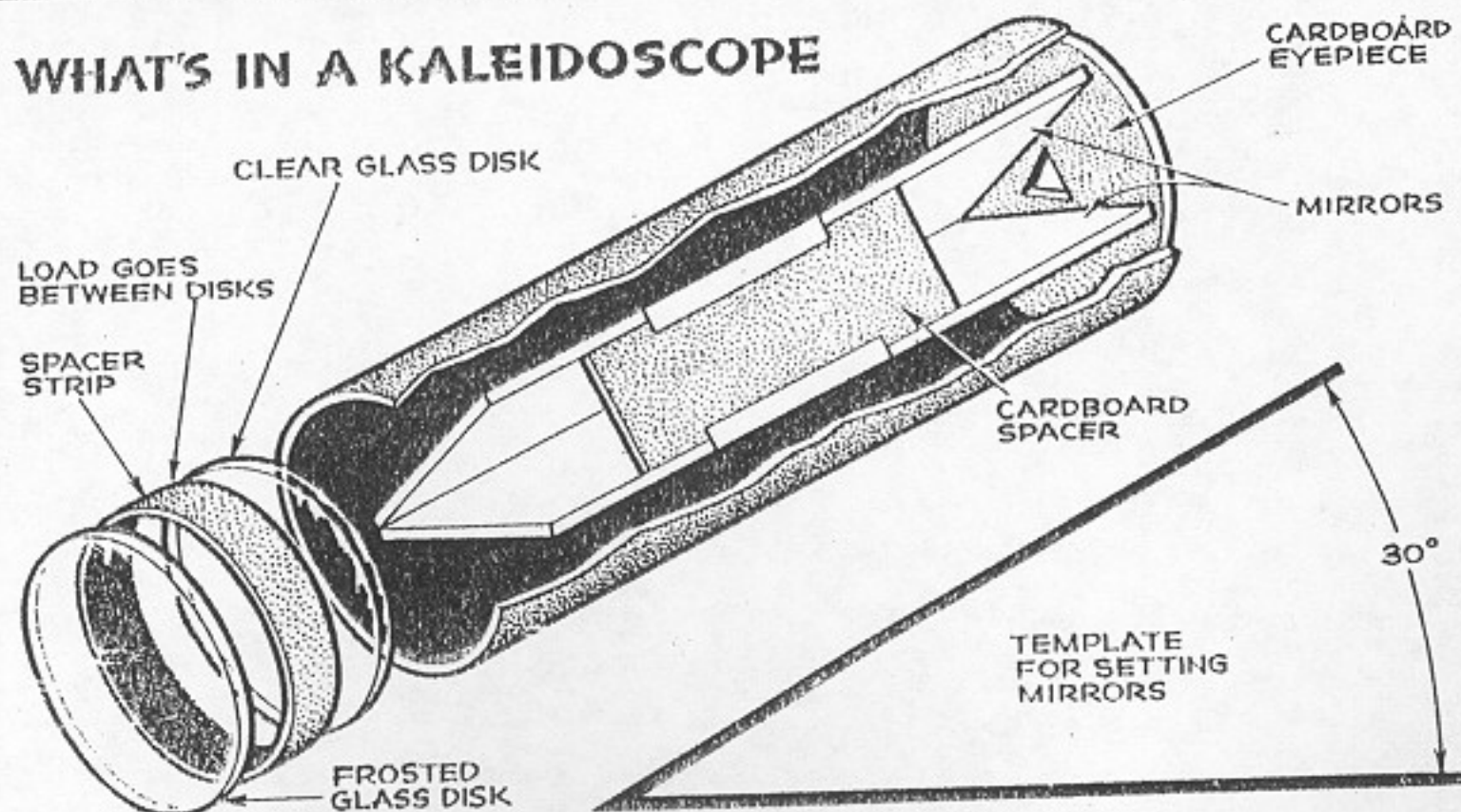


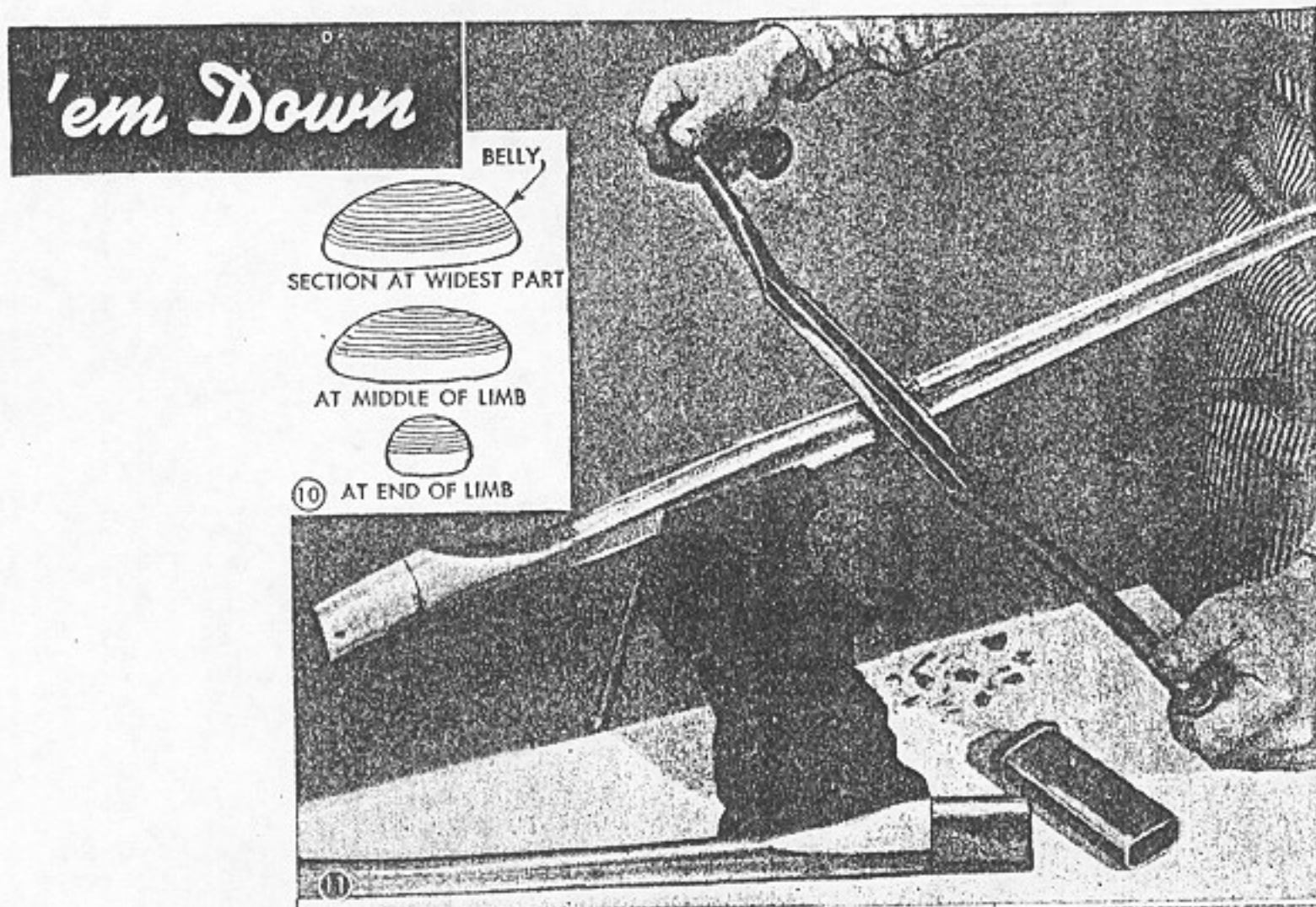
4 When the paint is dry, join the mirrors at one edge with adhesive tape, the unpainted sides facing. Set them on a drawn angle of 30 deg. or on the diagram below. Cut a cardboard spacer to fit closely within the outer edges

8 You are now ready to add the load. Bits of colored plastic, broken glass, beads, and scraps of celluloid are suitable. All should be translucent or transparent. Carved pieces, notched edges, and saw cuts yield odd effects



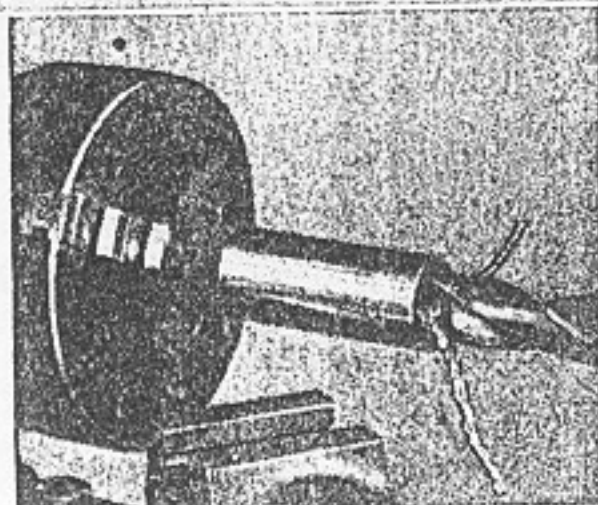
WHAT'S IN A KALEIDOSCOPE





The drawing weight need not be excessive; you can bring down the toughest game in the country, including moose, bear and wild boar, with a 45 to 50-lb. bow and a steel broadhead arrow. Most hunters prefer a flat or semiflat bow. The demountable type of semiflat bow described here is popular because of ease of transportation, and the knockdown handle in no way affects smooth, fast shooting. If this is your first bow, by all means make it of lemonwood, as this compact and nearly grainless wood permits mechanical shaping without any regard to grain structure. If you want the best, however, use osage orange or boam. Yew is good, too, although a little too soft for rough usage. All bow woods except lemonwood require careful following of the grain.

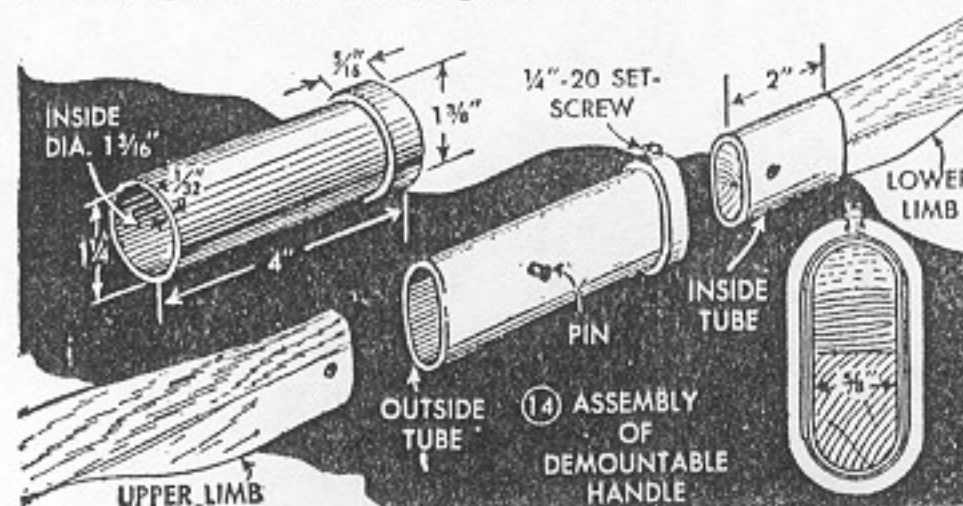
Start by roughing out the back of the bow. Osage orange is perfect in this respect; just peel off the bark, and the remaining layer of sapwood, about $\frac{3}{16}$ in. thick, is just right. Yew and boam have more sapwood and will require trimming down. This can be done best on a band saw as in Figs. 1 and 2, mounting the stave on a guide board and then saw-



(12) BORING THE HANDLE TUBE

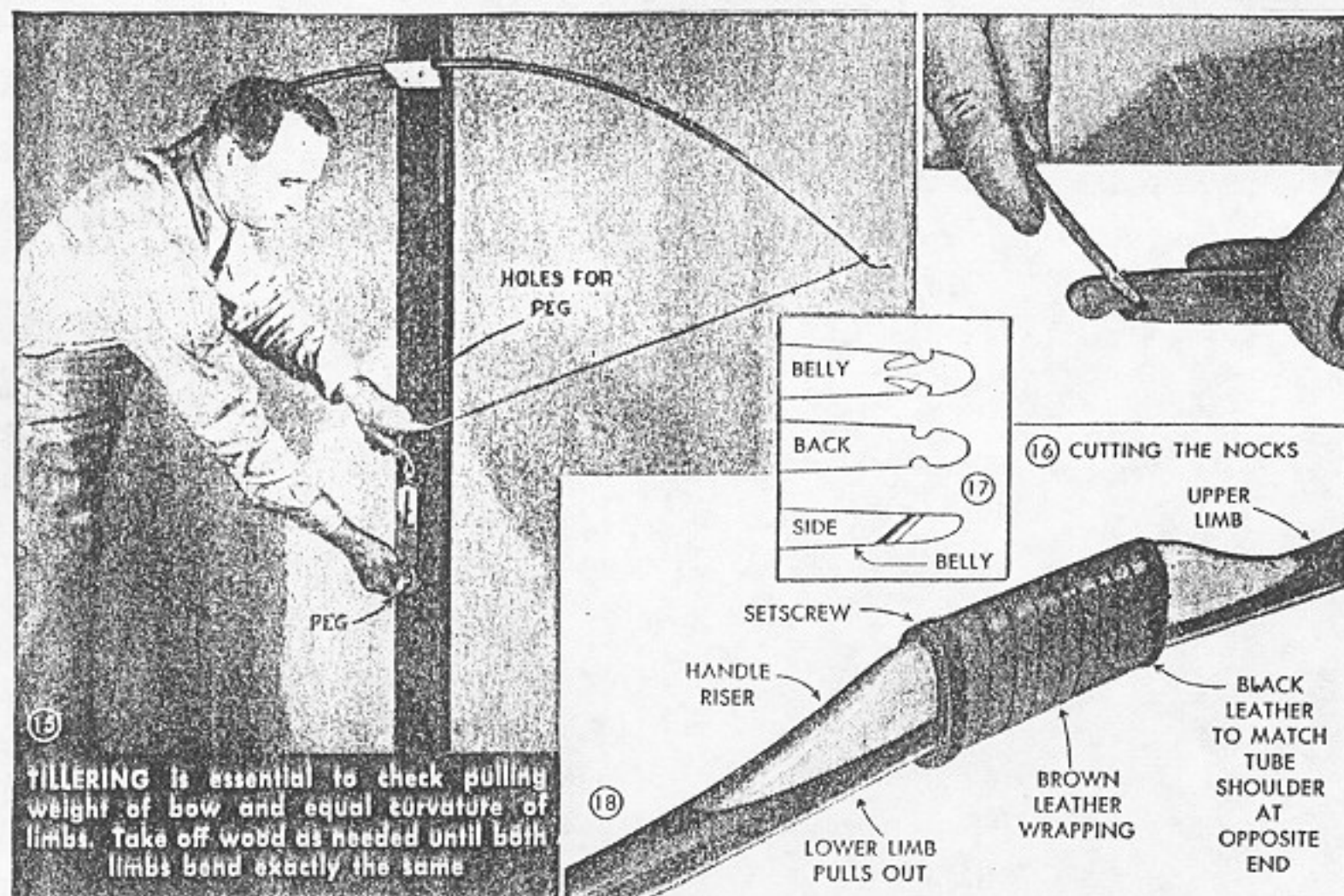


(13) VISE PRESSURE GIVES OVAL SHAPE



(14) ASSEMBLY OF DEMOUNTABLE HANDLE

THE HUNTING BOW should be as short as practical, with pulling weight of 40-60 lbs. Style shown is semi-flat, with demountable handle for ease in transportation.



ing on a line the required distance away from the heartwood. Pins holding the stave should be a snug drive fit in holes drilled squarely across the chord of the grain, as indicated in Fig. 1. If there is too much heartwood, it can be trimmed down with the same setup. Where there is just a little extra wood on the heart side, a planer head in the drill press will remove it in a jiffy, Fig. 3. In the absence of power tools, the staves can be trimmed with a drawknife. The first stage of cutting gives you a flat stick about $\frac{3}{4}$ by $1\frac{1}{2}$ in. with a thin layer of white sapwood on the back as shown in Fig. 5. Here you can see why it is easy to work with lemonwood; you have no sapwood to worry about, and the compact grain permits ripping and jointing to straight lines. All the other woods will be crooked, the back of the bow following every dip and curve in the grain. After band-sawing, smooth up the back of the bow with drawknife and scraper, following the grain. Fig. 4 shows table of net sizes for bows of different woods.

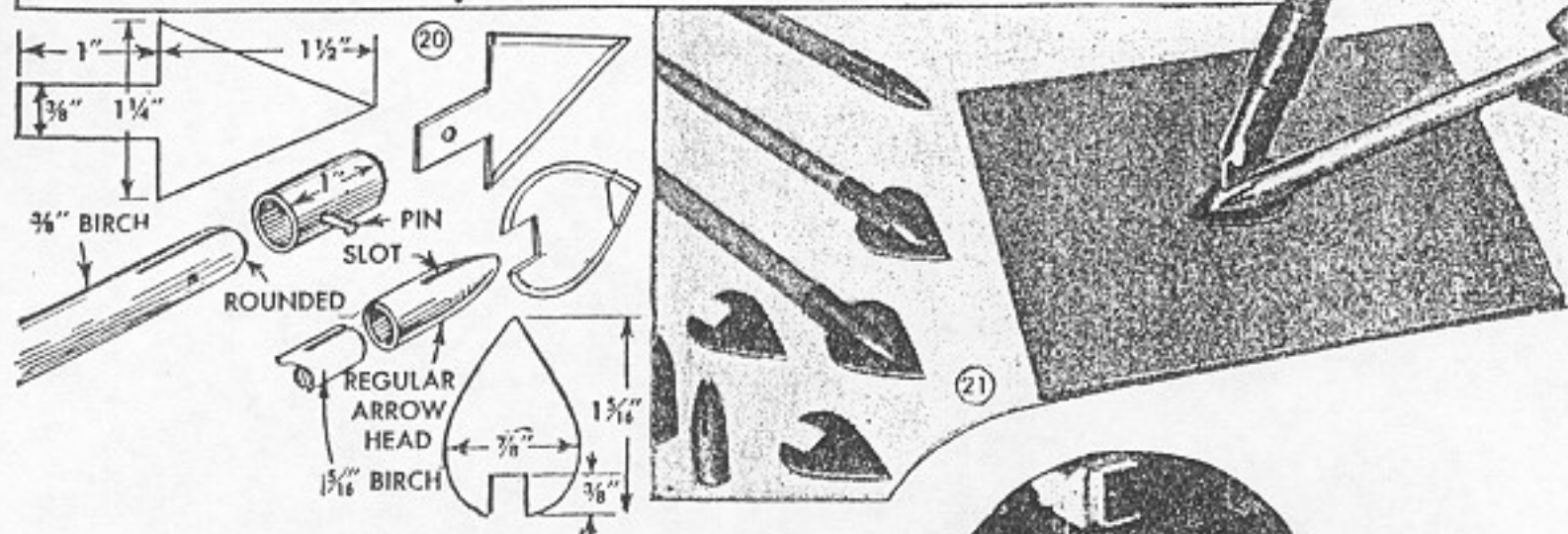
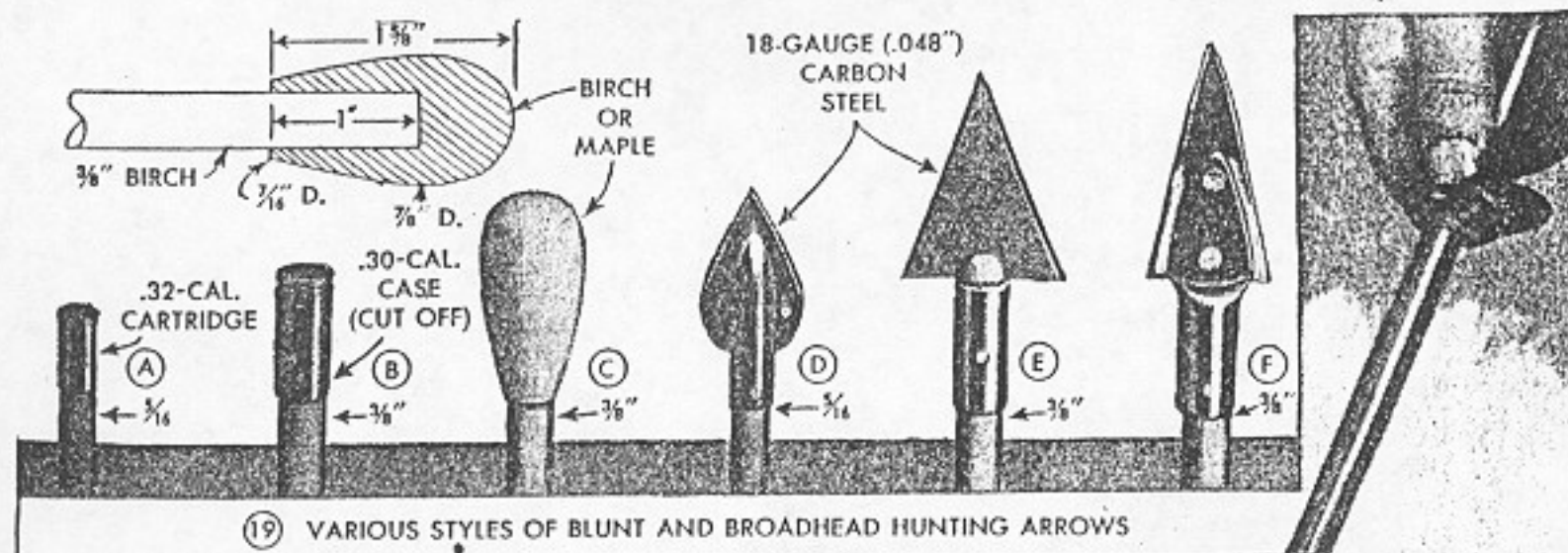
On the back of the stave, draw the outline shown in Fig. 5, band-saw to shape and taper the belly side as in Fig. 6. You will cut across the grain to some extent in both operations, but it is only on the back of bow that you positively must follow the grain. Glue the handle riser in place, Fig. 8, and then band-saw it both ways to the shape shown in Fig. 7. Both limbs of the bow are treated in the same way except that the upper limb should be 2

in. longer than the lower one, as in Fig. 9.

The demountable feature is accomplished by fitting the limbs of the bow inside a metal tube. You can buy telescoping tubes for this purpose, or you can make your own. Fig. 14 shows the general nature of the assembly. The short inside tube is pinned to the lower limb and the long outer tube is pinned solidly to the upper limb, the lower limb being a slide fit inside the outer tube, where it is held rigidly by means of a setscrew. Making your own telescoping tube is just a matter of turning and boring, Fig. 12, and then squeezing the assembled tubes in a vise as in Fig. 13, to get the required oval section. It is advisable to heat the work, otherwise the steel may crack at the shoulder portion. The original fit of the round tubes should not be too snug.

Figs. 10 and 11 show the final stage of shaping the bow, rounding off the belly with a drawknife or coarse and fine rasps. Osage orange may be so knotty as to require entire shaping by filing. Whenever you run into a knot, leave a little extra wood to compensate for the natural weakness caused by the defect. Finish off the limbs by scraping with a hook scraper or a piece of broken glass.

As you work down the belly side, tiller the bow frequently as shown in Fig. 15, checking its drawing weight, and more important, the bend of the limbs. Some workers tiller against a wall and use a grid of pencil lines to check for equal bending.

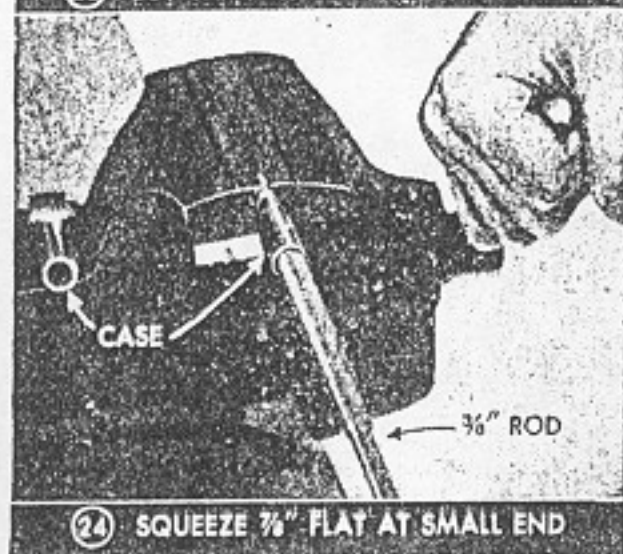
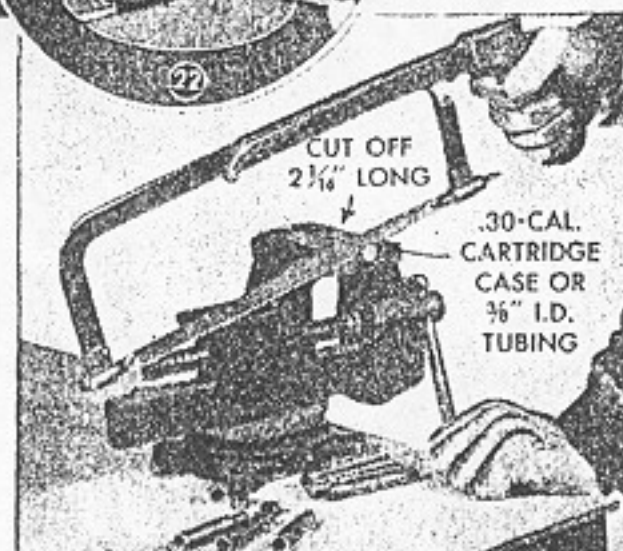
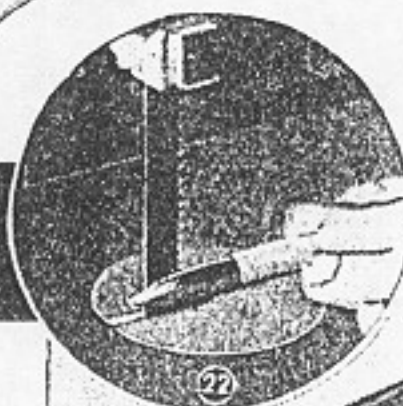


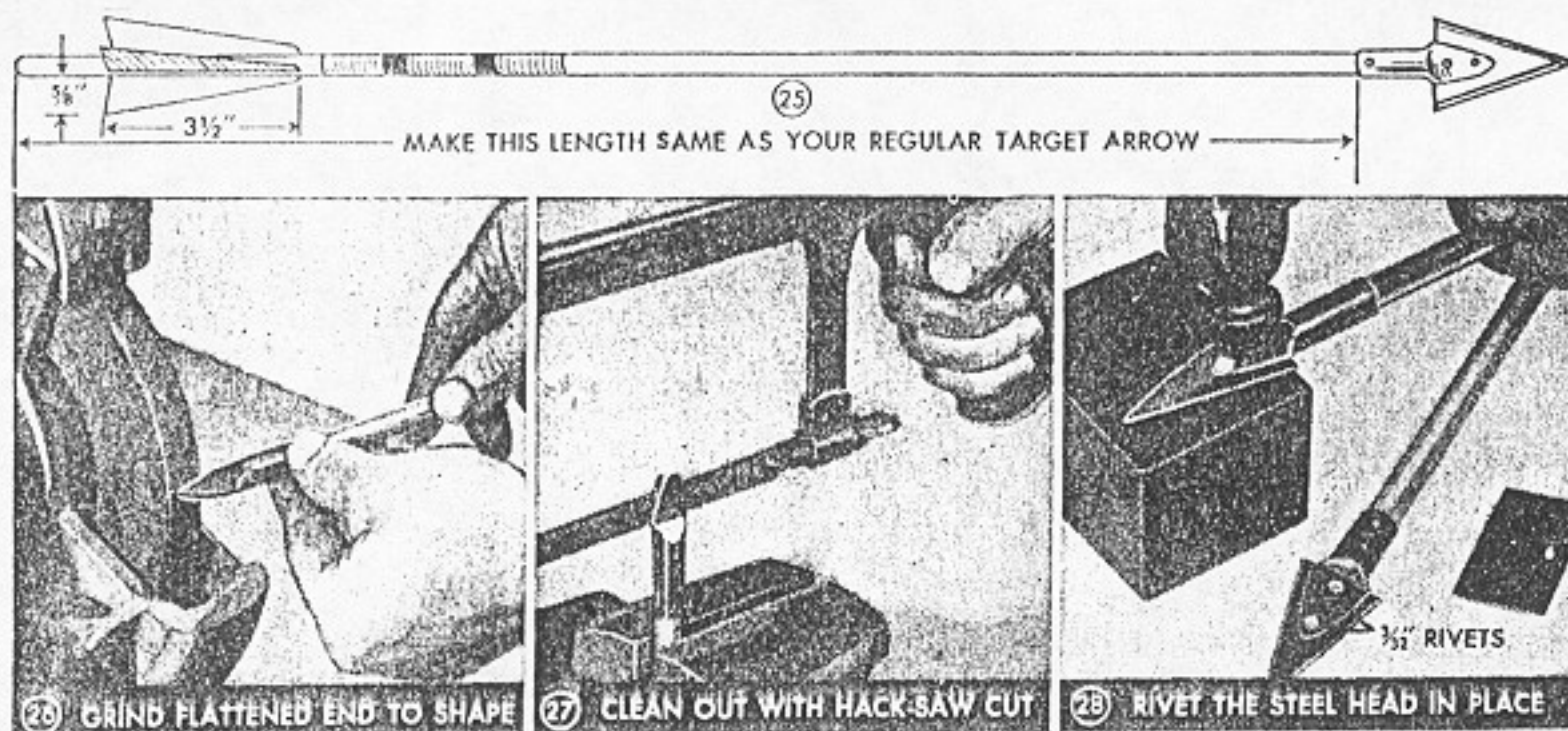
HUNTING ARROWS in blunt and broad-head styles are shown on this page. Steel for heads can be obtained from old power-hacksaw blades

However, good results can be obtained by eye inspection alone, and by noting if the string tends to pull off to one side as you pull it back. The bow should be rigid through the handle, and almost rigid the full length of the handle riser. Starting at the end of the handle riser, the limbs should bend in a graceful arc. Go slow at this stage; it is very easy to remove too much wood and ruin the bow. If you get a little under the poundage you want, cut an inch off both limbs and try it again. Get the pull about 5 lbs. more than you want; it will let down about that much after you have used it a few hours. If the bow is much too heavy throughout, make a fast dip immediately beyond the handle riser to get a thinner section, and then taper gradually to the tips. Nocks should be of the plain type cut into the wood as in Figs. 16 and 17. Fig. 18 shows the finished bow at the handle.

There are two kinds of hunting arrows: blunts and broadheads. The blunt points, details A, B and C of Fig. 19, can be made from cartridge cases or turned from wood. These heads have tremendous hitting power. They will bowl over a rabbit or knock a squirrel out of a tree. The need for the blunt point is obvious; you can imagine what happens to a sharp steel broadhead when you wham it into a tree trunk, or worse, a high tree limb.

Steel broadheads are needed for both small and big game. With sharp-cutting edges, even a 40-lb.





bow will send one of these shafts right through a two-point buck. The smallest practical head is the lancet shown at D, Fig. 19. This is made by slotting a regular bullet-type arrow head, and then soldering the notched steel head into the slot as in Figs. 20, 21 and 22. Easiest type to make in any size of broadhead is the tang-and-sleeve style shown at E and explained in Fig. 20. The step-by-step operation in making a broadhead, style F, is shown in Figs. 23 to 28. If you use .30-cal. ball cartridge cases, it will be necessary to have a tang on the broadhead for needed strength. With a sleeve of thicker copper or steel tubing, the split ends of tube alone will hold the head, which can be made a simple,

triangular shape without tang. Old power hacksaw blades furnish good steel for heads. All of the styles shown can be purchased readymade if desired. Fletching of shafts follows standard practice except that the feathers are preferably of the low, long triangular style as shown in Fig. 25. Complete construction kits including heads, cut feathers and birch shafts can be purchased at a nominal cost and provide an ideal method of working. The diameter of shafts will depend somewhat on the pull of your bow. If the pull is 40 lbs. or under, $\frac{5}{16}$ or $\frac{1}{32}$ -in. shafts are plenty heavy. Bows pulling over 45 lbs., especially when big broadheads are used, must have $\frac{3}{8}$ -in. shafts to stand up under the terrific impact.

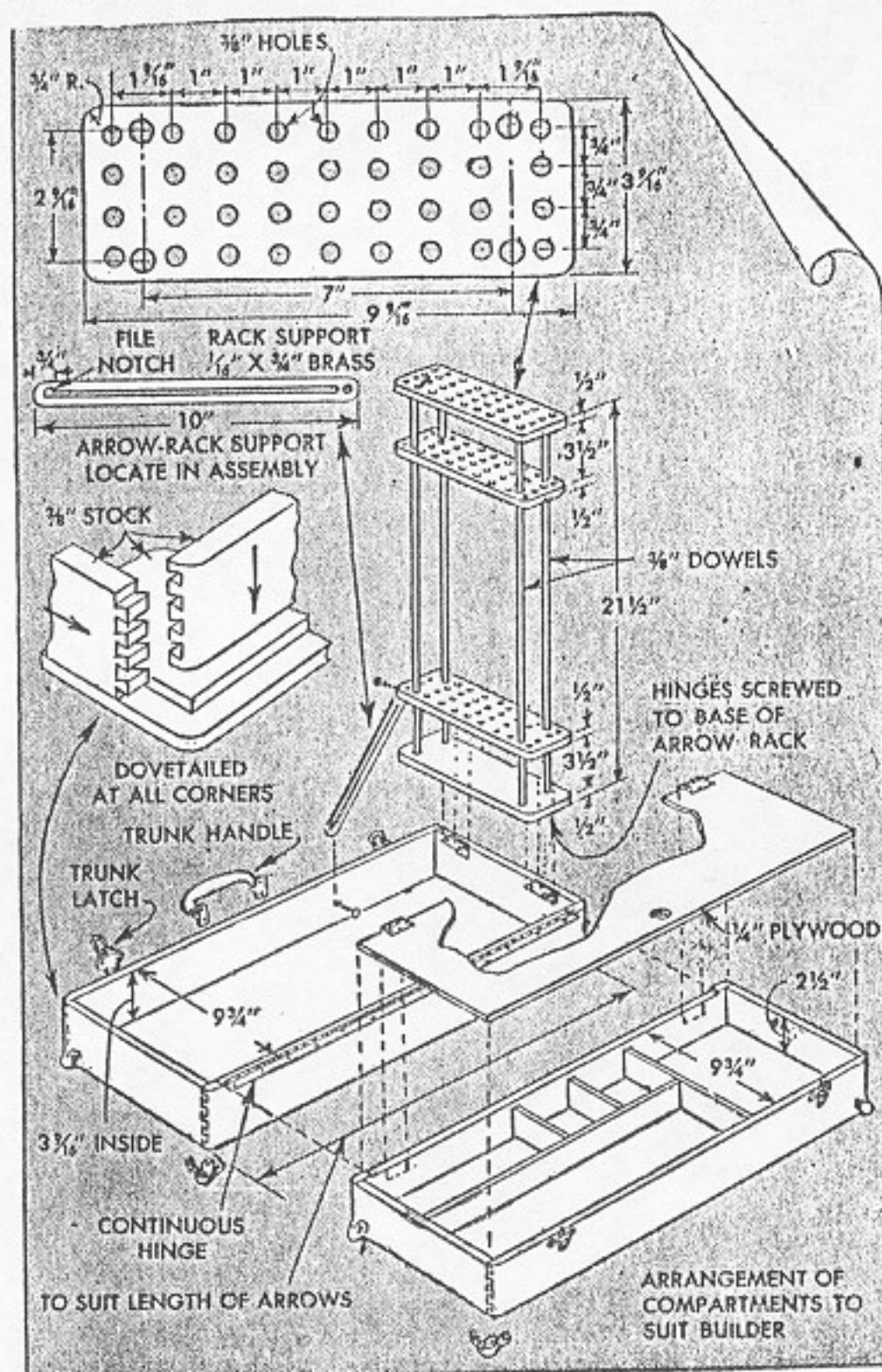
ARCHERY KITS

Compact and easy to carry, this archery tackle box has space for almost everything that's needed in the field. Compartments can be arranged to suit your convenience



IF THE over-all dimensions shown on the drawing are followed, one half of this

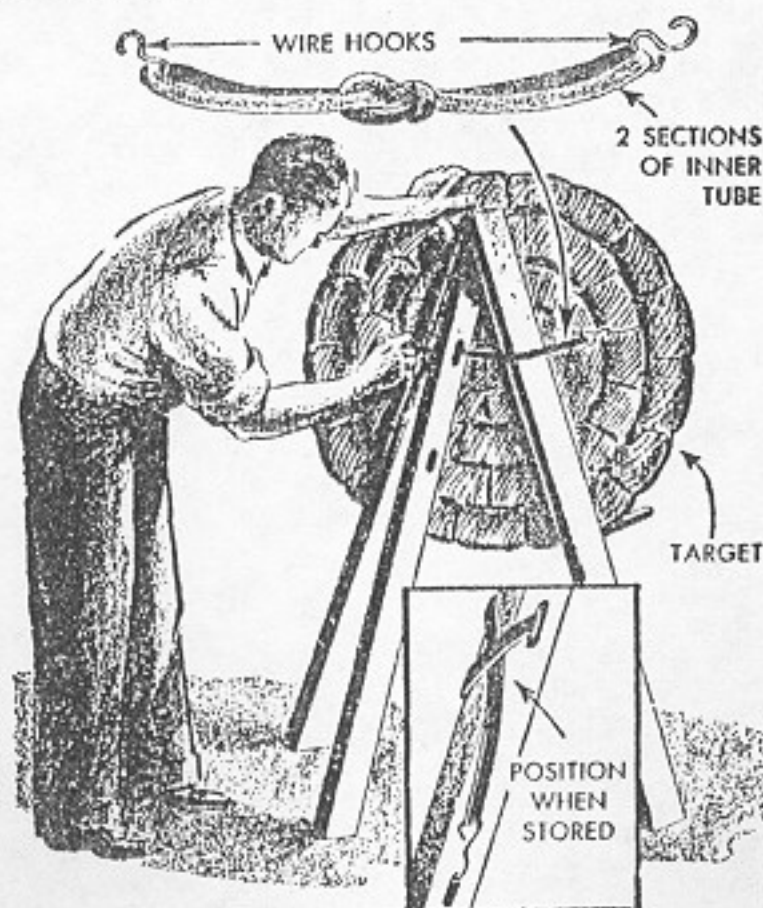
archery tackle box will have space enough for 36 arrows and the other half can be



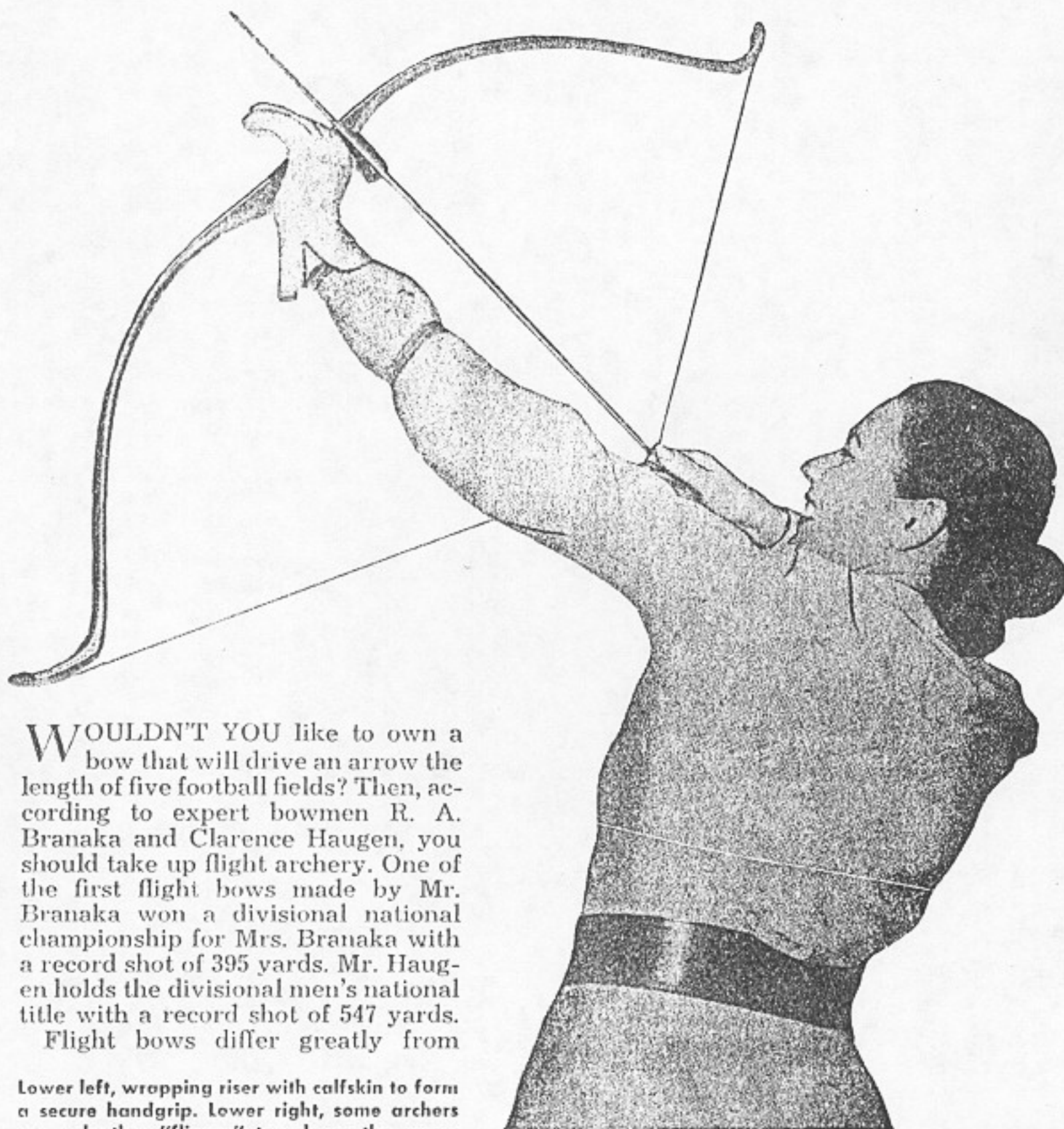
divided into compartments to carry such necessities as arm guards, gloves, string wax, repair thread and other items that are a part of every archer's kit. The corners are dovetailed and the two sidepieces are rabbeted for a close fit. Arrangement of the compartments is made to suit your own requirements. The dividing section fits into the half that contains the compartments and has a finger hole reinforced with a metal grommet. Construction of the rack for the arrows is shown in the upper and right-center details. Notice that the metal arrow-rack support is fitted after the rack is completed and hinged to the box. After the two halves of the box are joined with a continuous or piano-type hinge, all corners are rounded and fitted with metal reinforcements. The handle and latches are of the type used for trunks.

ARCHERY TARGET

There will be no possibility of a strong wind blowing your archery target off its tripod and possibly breaking expensive arrows if you attach it to the tripod as shown. Two strong rubber bands cut from an old inner tube are fastened together to make one long band and then fitted with hooks. The band is run through a hole in one leg of the tripod and is hooked into the target as indicated. When not in use, the band is hooked into the hole in the tripod leg to prevent losing it.



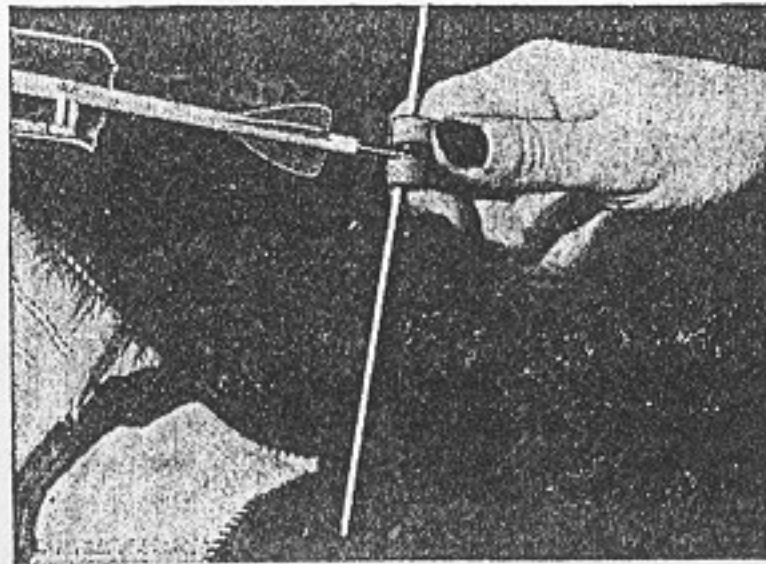
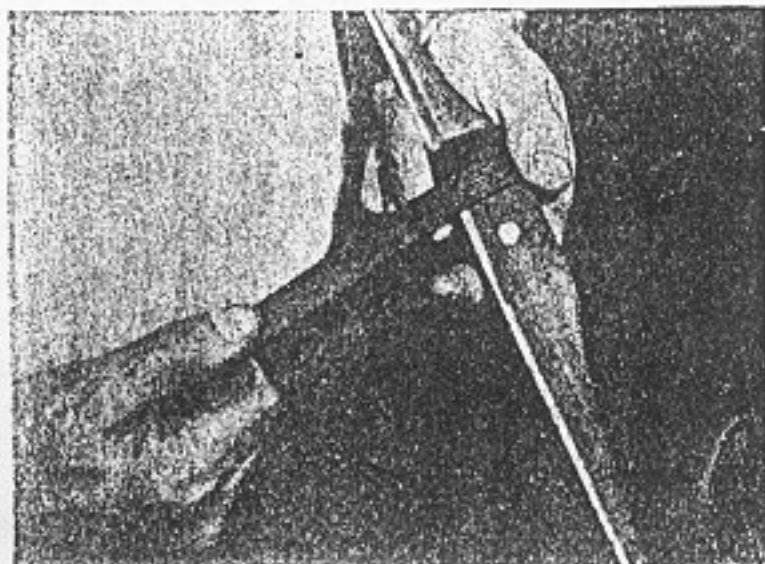
ARCHERY—FLIGHT BOWS

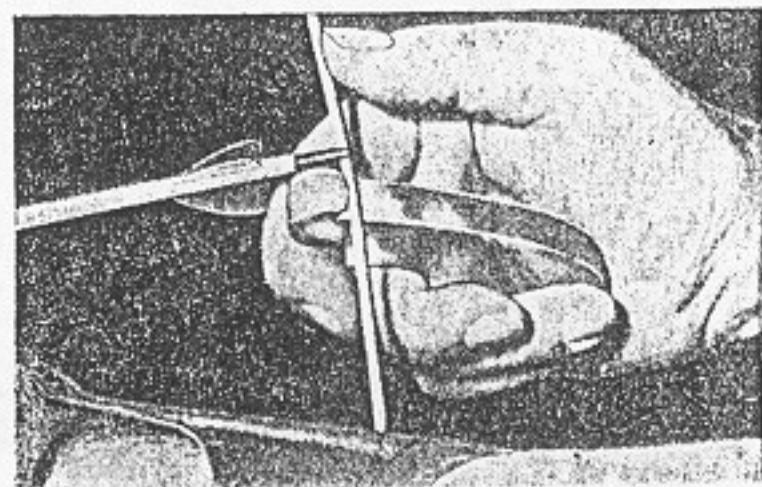


WOULDN'T YOU like to own a bow that will drive an arrow the length of five football fields? Then, according to expert bowmen R. A. Branaka and Clarence Haugen, you should take up flight archery. One of the first flight bows made by Mr. Branaka won a divisional national championship for Mrs. Branaka with a record shot of 395 yards. Mr. Haugen holds the divisional men's national title with a record shot of 547 yards.

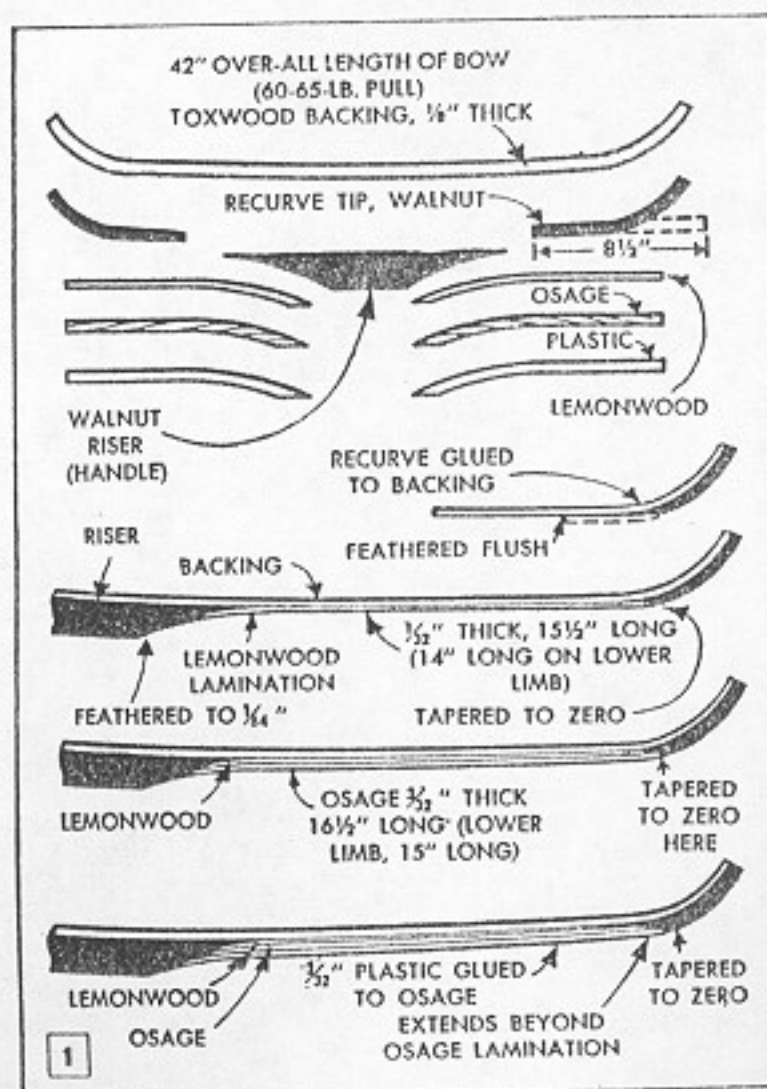
Flight bows differ greatly from

Lower left, wrapping riser with calfskin to form a secure handgrip. Lower right, some archers use a leather "flipper" to release the arrow





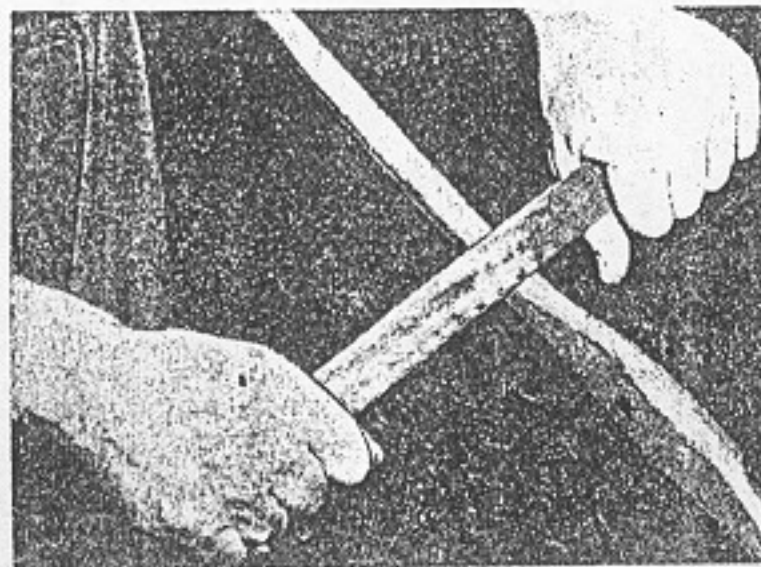
The hook-type release is used by many flight archers

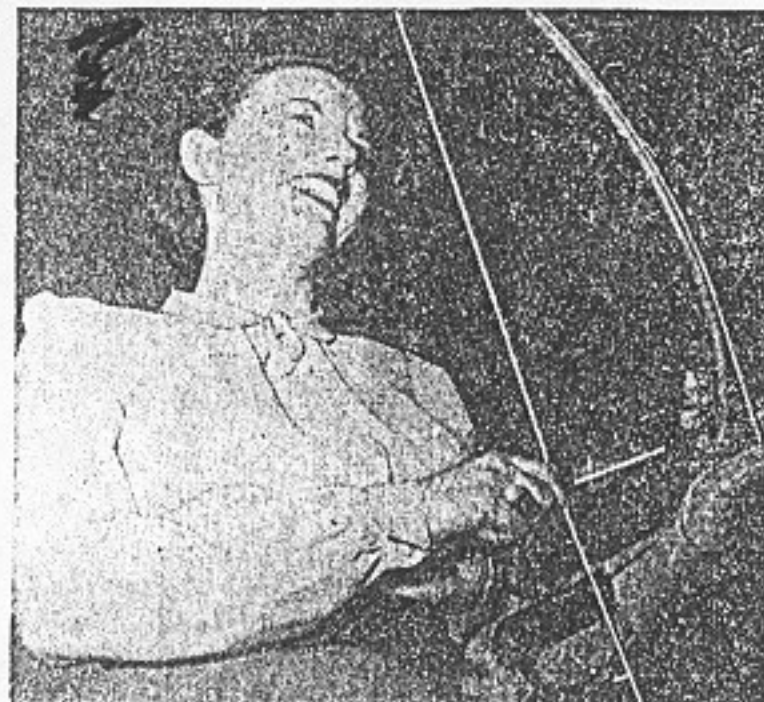
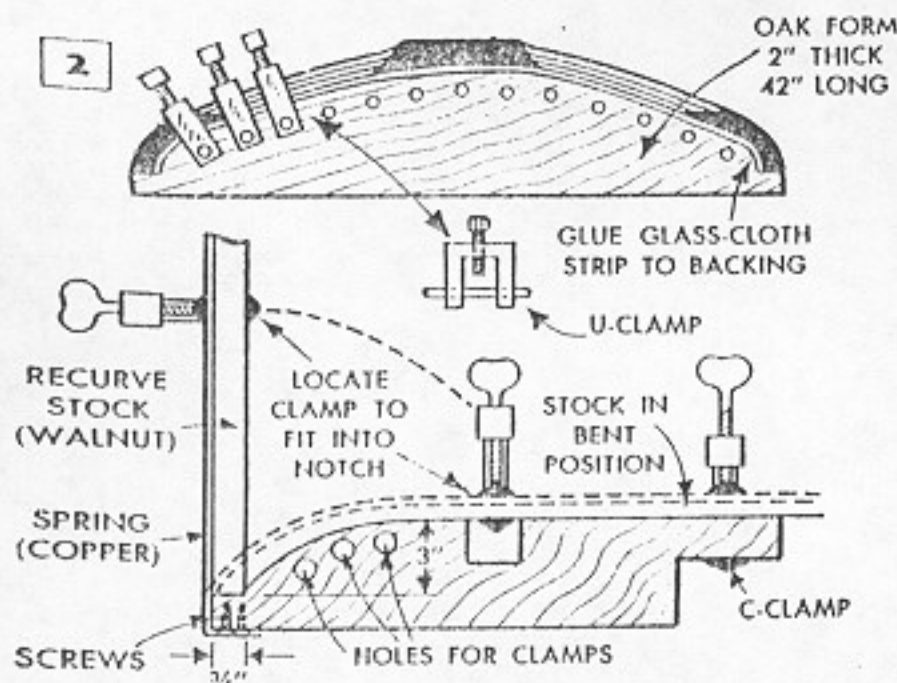


those made for target practice or hunting. They are short and sturdy, and because they are made of special laminated materials including several kinds of tough, springy woods, flight bows have tremendous driving power. Building a flight bow, as in Figs. 1, 2 and 3, is a procedure employing such hand operations as rasping, scraping, sanding and polishing a single piece to several sectional sizes. For this reason it is not possible to detail and describe each step of the process. The first step is to build the two bending forms detailed in Fig. 2, as you will need these as soon as you begin construction of the bow. One form is used for bending the recurve tips, Fig. 1, and the other is specially made for applying the glass-cloth (Conlon) strip to the backing as in the upper detail, Fig. 2. Special clamps are made for use with this form by bending $\frac{3}{8} \times 1$ -in. flat steel to a U-shape and drilling $\frac{5}{16}$ -in. holes near the ends for a $\frac{1}{4}$ -in. pin which is inserted through a hole drilled in the form. The web of the clamp is drilled and tapped for a cap screw. This type of clamp makes it necessary to protect the bow with a strip of sheet metal to prevent damage from the end of the screw as it is turned down. The large form is 42 in. long, which is the finished length of the bow, and the curved ends are cut on a $3\frac{1}{2}$ -in. radius.

Bowmakers usually begin construction by making the riser (handle) and the recurve tips. The latter must be steamed for at least 30 minutes before they can be bent over the form. The walnut stock is $\frac{3}{8}$ in. thick and 1 in. wide. The tips are cut to 14-in. lengths before bending. The riser, Fig. 3, is cut with a 10-in. radius at each end. It should be noted that in the assembly of the laminations the riser is slightly off-center. Note also that the bow has two parts, the upper half being referred to as the upper limb and the lower half as the lower limb. After the riser has been sawed to the rough

Flight bow being roughed with special scraper made from power-hacksaw blade. Operation is known to archers as tillering. Wood rasps may also be used

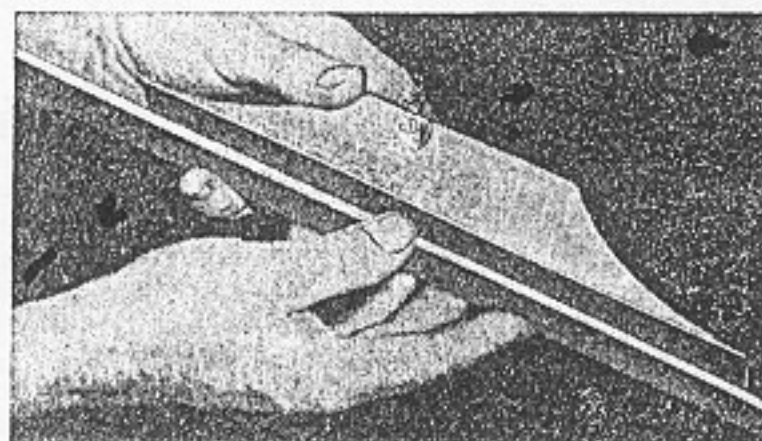




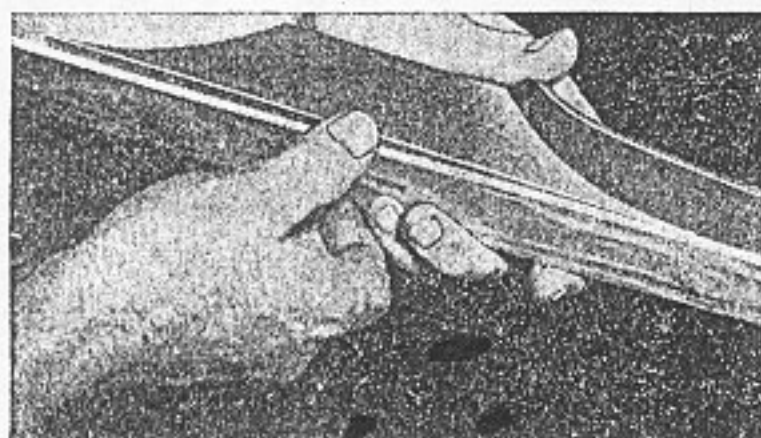
Arrows used in flight archery are made by professional arrow makers because they must be accurate

form and the curved surfaces smoothed by sanding, it is glued to the center of the toxwood backing strip. (Toxwood consists of thin layers of selected maple bonded with a special resin adhesive.) Before the glue dries, wipe off all the excess so that a smooth joint results. Next, the walnut recurve tips are steamed and bent. After drying thoroughly in the forms, they are removed and cut to 8½-in. over-all length and glued to the toxwood backing. The lower ends of the tips are feathered flush before the lemonwood laminations are applied. Note that these are 14 and 15½ in. long, Fig. 1. At the riser ends, the lemonwood laminations are tapered to 1/64 in., but are feathered or tapered to zero at the outer ends where they join the recurves. Apply the Osage laminations in the same manner, but note before cutting stock that one is 15 and the other 16½ in. long. Locate the center of the bow and measure 4½ in. each way. Then bandsaw the riser to the form shown by the dotted lines in Fig. 3. The recurve tips are tapered by hand, the dotted lines serving merely as guides to the rough size. At this stage the bow is ready for nocking and rough shaping, or tillering.

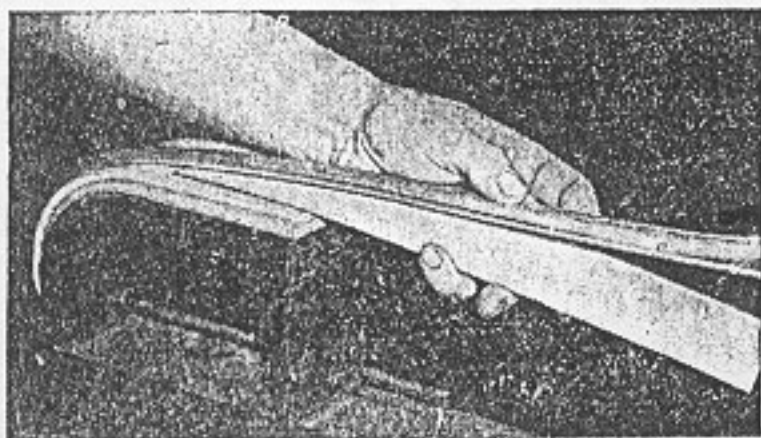
The recurve tips are nocked for the bowstring as in the center photo on the opposite page. Use a 3/16-in. round file and file the notch at approximately the angle indicated. The notch should continue around to the opposite side of the tip. Be sure that it is cut to the same depth and at the same angle on both sides of the tip. Brace (string) the bow with a linen bowstring. Then hold it firmly in a padded vise and scrape the limbs to bring the bow to the proper tiller, or bend. This is one of those jobs that must be done by stages with frequent periods of testing with a spring scale. Bowmakers usually use a fish scale for testing. Scraping can be done with a cabinet scraper with fair

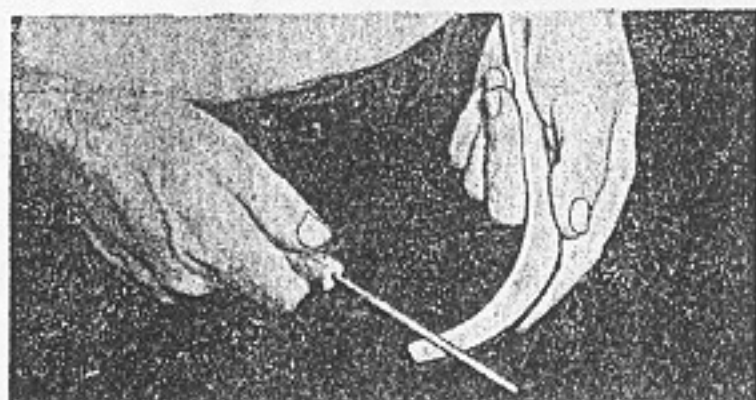
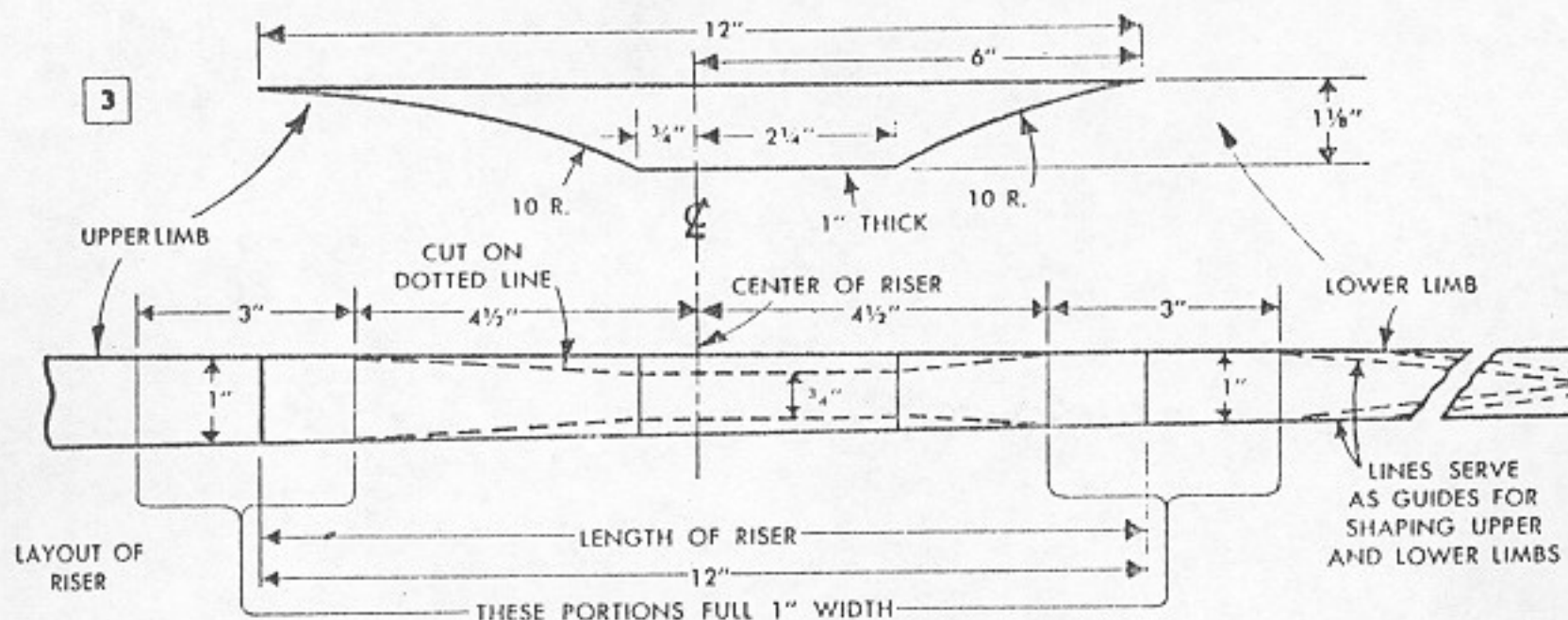


Riser is first glued to toxwood strip, which consists of resin-bonded layers of maple selected for grain



Above, the lemonwood lamination follows curve of the riser and is tapered to 1/64-in. thickness at the end. Below, professional bowmakers use a special bending jig of this type for bending recurve tips





Upper photo, one of several types of plastic overdraw attachments. Center, cutting nocks (notches) in the recurve tips of a flight bow. Below, bowmakers finish the bow by dipping in tank containing varnish

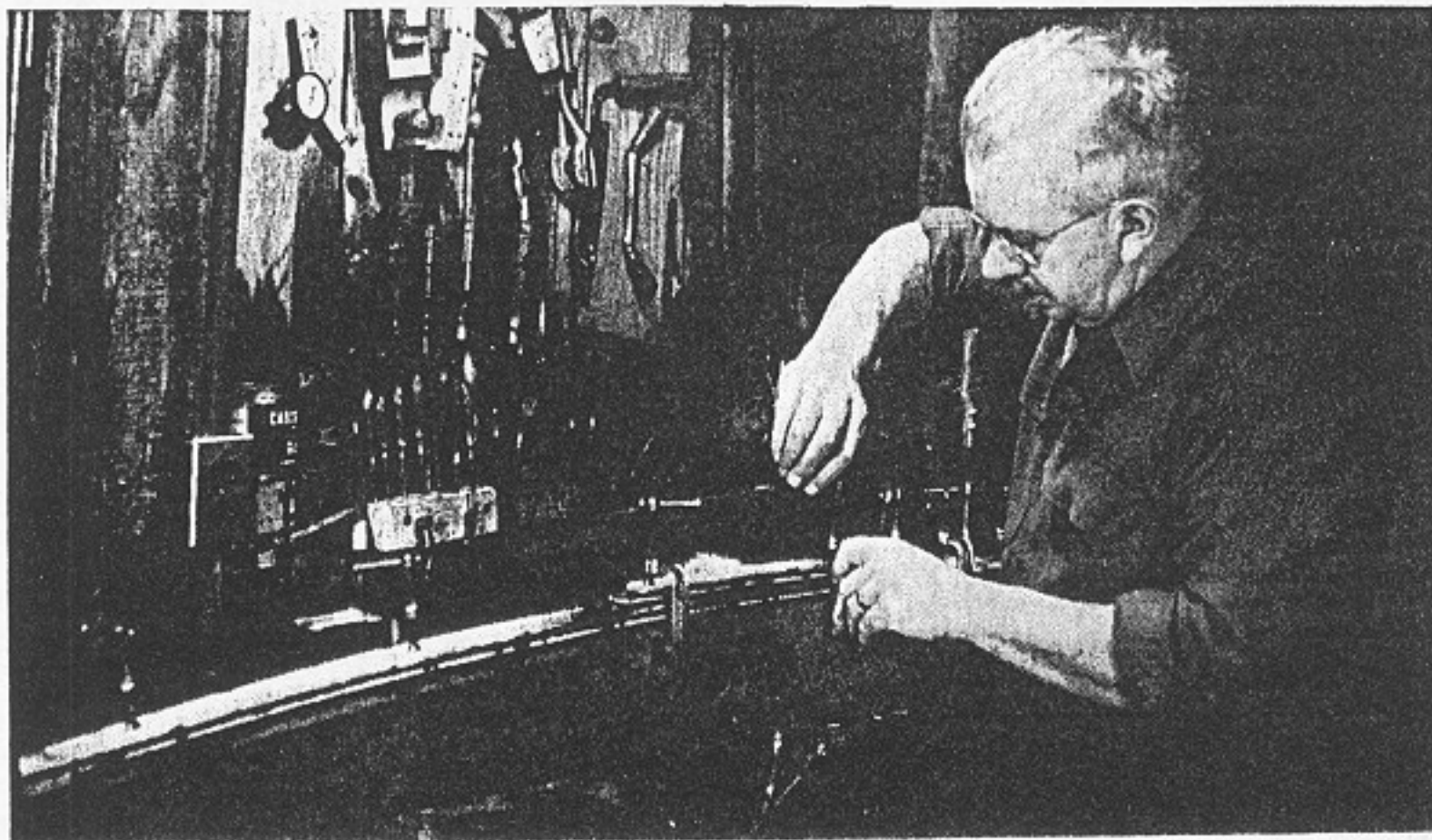


success but bowmakers prefer a discarded power-hacksaw blade having one side ground to a cutting edge. As the scraping proceeds, check the pull with the spring scale, drawing the bowstring 24 in. from the center of the bow at each trial check. As each check is made, note carefully the arc of each limb of the bow. Both should flex to the same arc during the test. If not, scrape excess stock from the stiffer one until both flex uniformly when the bow is braced.

When tillering and scale checks bring the pull to about half the desired weight of 60 to 65 lbs., the bow is ready for application of the plastic, which is glued and clamped in place in the same manner as the other laminations. Application of the plastic will increase the pull somewhat beyond the 60 to 65-lb. limit and it will be necessary to continue the scrape-and-weight-check procedure until the desired pull is restored.

The final step in building up the laminations is the application of a Conlon (glass cloth) strip to the toxwood backing. A length of glass cloth slightly longer than the bow is placed over the large bending form. Coat the toxwood backing with glue and place the bow on the form over the glass-cloth strip. Then apply U-clamps and allow to dry thoroughly. Once more it will be necessary to scrape the bow to restore the proper pull. Work carefully and check frequently this time or you may exceed the limit. When the pull has been correctly established, sand the bow to a glass-smooth surface and apply two thin coats of varnish.

Now, how about the proper technique of flight-bow archery? You'll have to use the trial-and-error method to discover that. But to get yourself started on the right foot, it would be advisable to contact your local archery club for some pointers. Then keep practicing until you attain a smooth, one-operation maneuver.



Powerful laminated bows for hunting or target shooting are built in a jig like this one.

POPULAR SCIENCE

FEBRUARY 1949

How to Make Laminated Bows

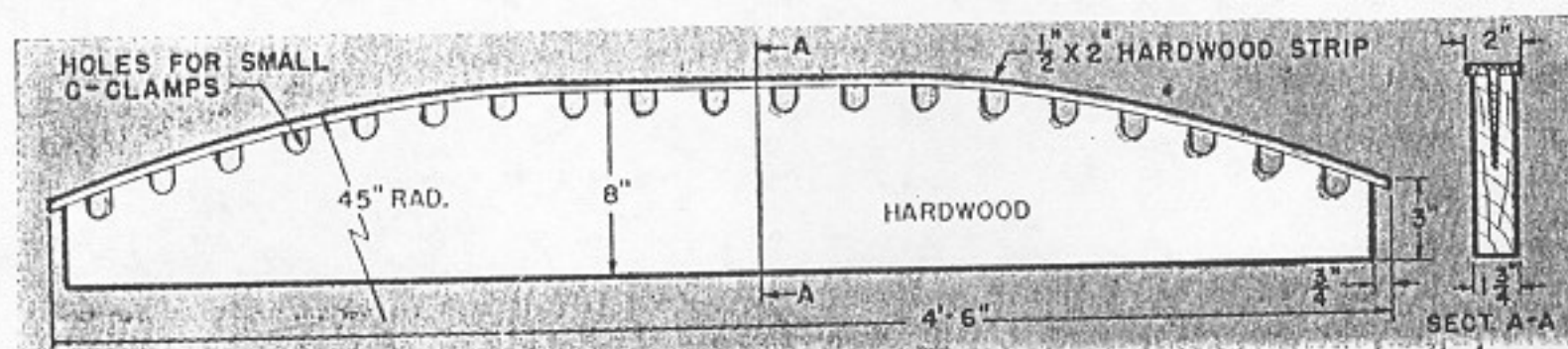
LAYER-BUILT bows—streamlined, hard-hitting, and almost unbreakable—are coming into wider use by both hunting and target archers. These bows, glued up in a jig, use various woods, and sometimes other materials such as horn, fiber, or plastic.

Hickory usually goes into the back layer because of its tensile strength, although bamboo sometimes is used. The center lamination does very little work. It mostly provides stiffness. A popular choice for this layer is yew or walnut. For the belly layer—the string side of the bow—osage orange is preferred by most bowmen.

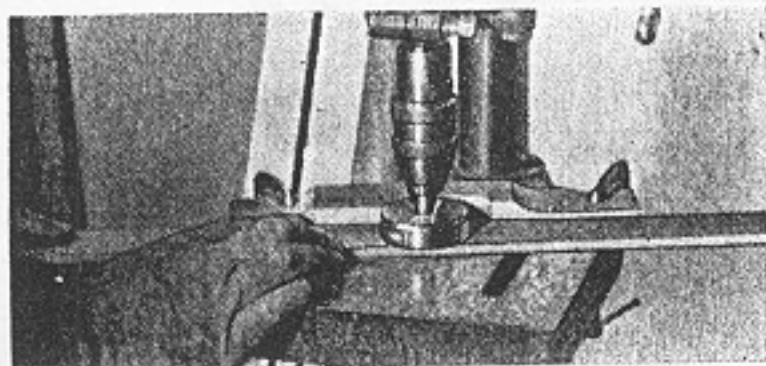
For the heavy, short bow favored by hunters, a $\frac{1}{8}$ " layer each of hickory and yew and a $\frac{3}{16}$ " layer of osage orange is a good combination. All three laminating strips, plus several short strips for the handle riser, are coated with glue, assembled, and clamped in the jig at the same time.

Tracy L. Stalker, of Flint, Mich., who designed the jig shown at the bottom of this page, uses a resorcinol-type glue. It's strong, waterproof, and gives ample time to assemble the strips. Depending on the room temperature, you can allow from 15 to 30 minutes between the time this glue is applied and the clamps are tightened. The warmer the room, the quicker the glue sets.

Although bows usually are of wood, a powerful composite bow of horn and wood has long been used in Asia. A bow of this type is on record as shooting an arrow 482 yards. However, horn is difficult to use and a composition of compressed wood and plastic has been developed as a substitute. It



Jig is $1\frac{3}{4}$ " hardwood with 2" top piece and series of closely spaced notches to take C-clamps.

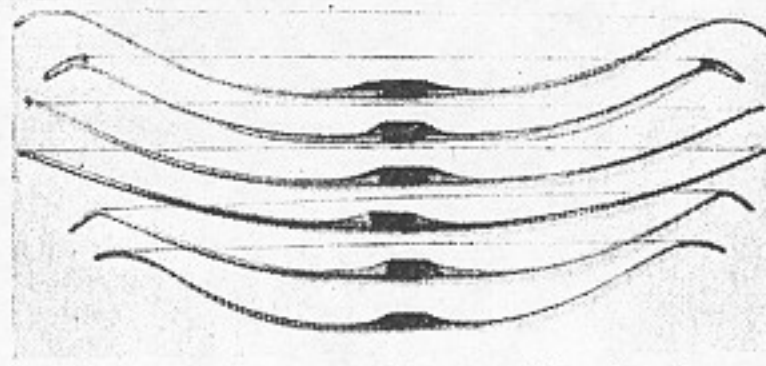


Laminating strips must be true and flat or unsightly glue joints will result. Above, a strip is leveled with rotary planer in a drill press.

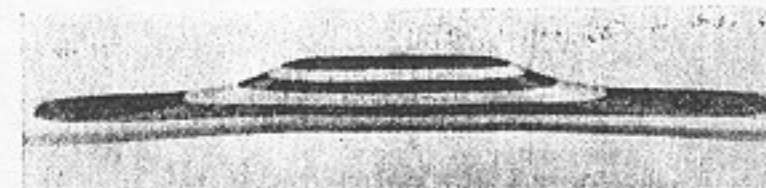
will add as much as 30 pounds to the drawing pull of a 5' bow with limbs $1\frac{1}{2}$ " wide. This facing is glued to the belly while the bow is clamped in a reflexed position.

Another way to improve the cast of a bow is to glue a strip of hickory to the back. Use a piece of hickory as wide and as long as the bow and from $\frac{3}{32}$ " to $\frac{5}{32}$ " thick. After sanding the wood and applying the glue, clamp the bow and backing strip in the jig in a reflexed position. Bows glued up while reflexed tend to bend backward when unstrung. Then when they are strung, they are in a high state of stress even before an arrow is drawn. This gives them their power.

When gluing up bows or when adding a strip, first clamp each limb lightly at the end and in the center. Leave these clamps loose enough so the strips can adjust themselves



Six typical laminated bows. The fourth one from the top was built up of a fiber back and 10 thin laminations of lemonwood.



This shows handle construction of alternate layers of walnut and maple. These are glued up with the bow and later rounded off.

as the clamps are tightened. After the first three clamps, start at the handle or center and apply clamps toward each end. Tighten them until all excess glue is squeezed out.

Leave the bow in the jig for at least 10 hours if the temperature is about 70 deg. A good test is to note whether the squeezed-out glue is hard. The joint then is generally cured enough for handling, and the bow can be finished.

WHIRLING-BALL TOY TESTS DEXTERITY

A WHIRLING toy that will give hours of amusement can be made in a few minutes. It consists of two 1-in. wooden balls, one painted red and the other green, and both drilled so that a cord can be run through them. The cord for one ball is 14 in. long and for the other, $15\frac{1}{2}$ in. The ends of the cord are passed through a cylinder of wood about $\frac{1}{2}$ in. in diameter and 2 or 3 in. long. The hole through the cylinder should be just large enough to take the two cords, but at one end the hole should be enlarged to a diameter of $\frac{1}{4}$ in. and sanded to a very smooth finish. The cords are passed through from this end and knotted at the other end as shown in the accompanying diagram.

Spin the ball on the shorter string in one direction very slowly. Then attempt to start the other ball whirling in the opposite direction. After a little practice, you will be able to make the balls rotate at high speed in opposite directions, forming a pleasing blur of color.



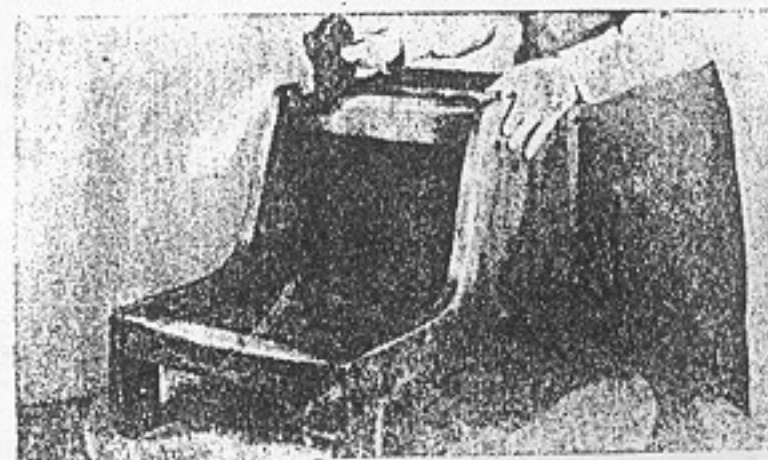
ANTIQUES—REFINISHING

A master craftsman, wise in the ways of refinishing antiques to the smoothness of old ivory and with a gleaming, rich luster, gave me the following tips: First, clean the work with a good paint and varnish remover, using a cheap brush to apply a generous coat over a small area. Let the remover stand about 15 min. and, without wiping it off, apply a second coat. Then mix a gallon of warm water with a cup of household ammonia and use the mixture with a stiff-bristled brush to scour the treated surface. Dip a rough cloth (an old towel is excellent) into the ammonia water and wipe the area. Rinse at once with clear water, removing all traces of ammonia and the work should be good and clean. Remember to clean only a small area at a time, for if varnish remover is applied over too large an area, it will harden into a cement-like finish. Should that happen, apply more remover—several coats, 15 min. apart—until you can wipe the surface clean. Before further refinishing is done, make any nec-

essary repairs to the work. Then sand with 1/0 or 2/0 garnet or sandpaper until very smooth. Wipe clean and apply the first coat of shellac, using a 4-lb. cut. Thin a pint of shellac with a pint of denatured alcohol. Use orange shellac on dark woods, such as mahogany, cherry and walnut, and white shellac on the lighter woods. Using a pure bristle brush, apply two coats of shellac with the grain of the wood, allowing 4 or 5 hrs. between coats. Between succeeding coats, allow 24 to 48 hrs. drying time. Sand after each coat using 6/0 or 7/0 garnet paper. Never apply shellac in damp or humid weather, and if the shellac gums up on the sandpaper, allow more drying time. When you have built up the desired number of coats, mix 3 heaping tablespoonfuls of fine pumice with paraffin oil to attain a creamy mixture. Then dip a pad of 000 steel wool in the mixture and rub the work briskly with the grain. When finished, wipe the surface with a soft cloth. Repeat this process twice.



Shading certain areas darker with stain or a different color with enamel is easily done with the spray gun, using a small pattern for good atomization to produce even blending

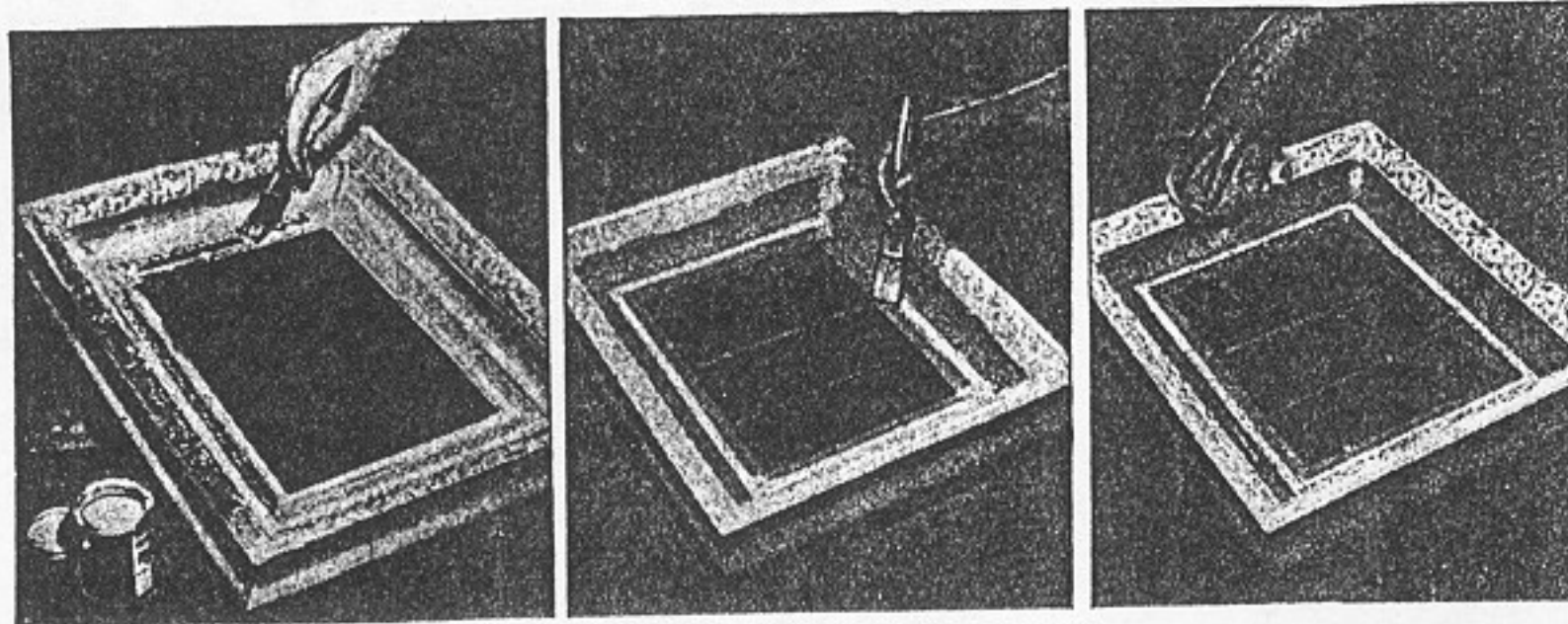
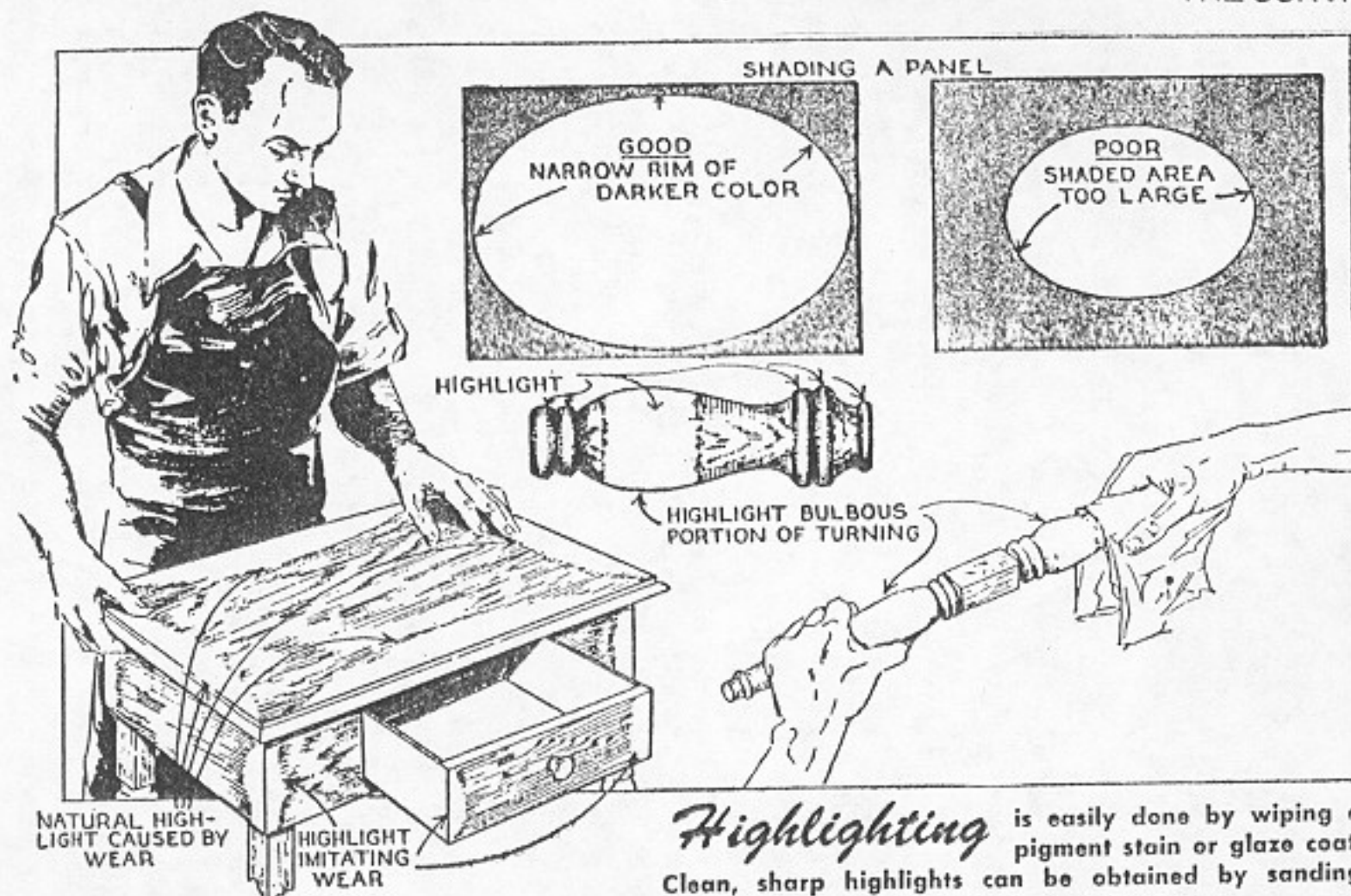


ANTIQUING

SHADING plays an important part in the finishing of period furniture, and also has a considerable role in the decoration of other projects in both wood and metal. Briefly, the technique is simply a matter of lightening or darkening certain areas of the work to contrast with the general tone of the piece. Related terms include highlighting, glazing, antiquing, smutting, etc.

Spray shading: The spray gun is an excellent tool for shaded effects, and is capable of either sharp or soft shading. Sharp shading is confined largely to colored enamels, an example being the shading of a cream-colored chair with blue enamel, as shown in the photo at left. The color separation is strong and sharply defined—it is a kind of shading that is plainly visible. On the other hand, soft shading, as done on the average piece of furniture, is hardly apparent at first glance.

Various methods are used in spray shading. Most direct is to shade the work during the application of the stain coat, spraying lightly on some parts, heavy on others. Again, a first coat of stain, considerably diluted, can be allowed to dry, after which a second coat can be sprayed for shaded areas. Shading can also be done at any time during the finishing schedule by using special shading stains. These can be purchased ready-mixed or made by mixing powder stain with thin shellac or lacquer. Soft



Glazing is the term for a shading medium or technique. In the example above, the ground coat is blue, left photo. The white glaze is brushed on, center, and then wiped to expose the highlights, as shown in right photo

spray shading should be done with a small spray pattern and with the gun held 10 to 20 in. from the work.

Highlighting: If you don't have a spray gun—or perhaps even if you do—you can do shaded work by the reverse technique of highlighting. This is easily done with pigment oil stain, penetrating oil stain, and to some extent is practical with almost any type of stain. Cleaner wiping for highlights can be obtained if done on a second coat of wiping stain applied over a sealer. That is, you stain first for a uniform body color, not too dark. Then apply a sealer coat. Over the sealer coat brush on a second coat of pigment wiping stain. Clean this off rather thoroughly with a rag to leave the stain

only on areas which are to appear darker.

Highlighting can also be done mechanically on the first stain coat after it is dry by using fine sandpaper or steel wool, as shown in the photo. This is sometimes useful to obtain a few very sharp highlights. It has the fault that if overdone, patching by restaining is not always easy.

Glazing: Glazing is the term which most nearly describes the whole art of using a wiped, translucent shading medium. You can glaze a piece of work and then wipe it for highlights. You can glaze the work with the idea of antiquing it. Or you can use a glaze coat for a textured ground or to imitate wood grain. The glaze itself can be any wiping stain, any thin paint, etc., but is

specifically a product called glazing liquid. This can be purchased ready made or can be made with varnish, 4 parts, boiled linseed oil, 2 parts, and turpentine, 1 part. Pigment colors in oil or japan are added as needed to obtain desired colors. The glaze coat is applied over a foundation coat of sealer or colored enamel. It is sprayed or brushed over the whole area and is immediately wiped with a cloth or blended out with a dry brush. It can also be applied with a cloth and wiped with the same cloth, a kind of rubbing-on process.

A soft-brown glaze on an off-white enamel ground (bone-white finish) is effective. The same on a cream ground gives a pleasing soft, shaded effect. For a clear finish, the glaze coat should be somewhat darker than the wood or the stained color of the wood. For colored enamel finishes, any of hundreds of color combinations can be used. An example is shown in the photos.

For most work, the glaze should be

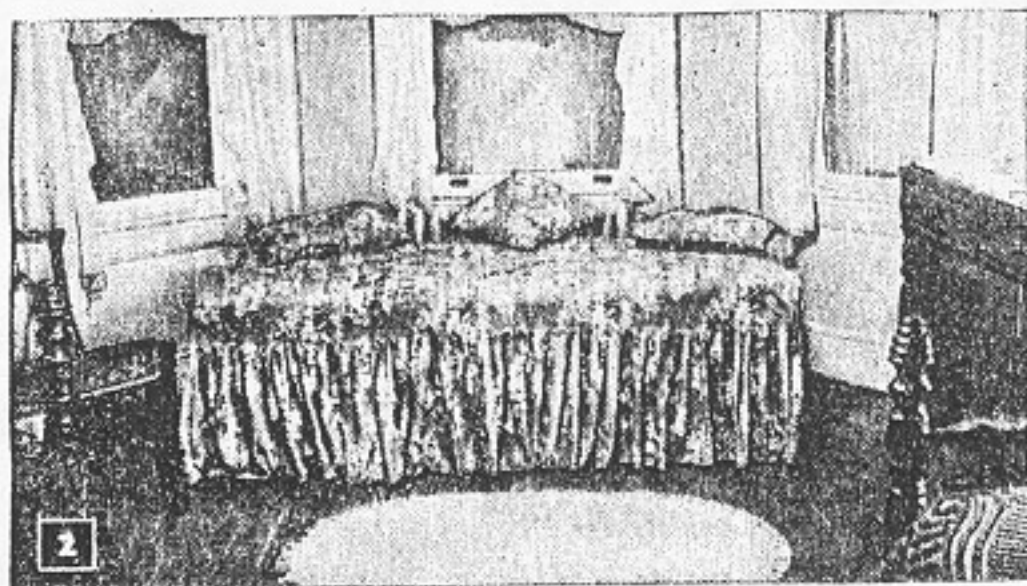
wiped rather thoroughly. Graining effects can be obtained by wiping the glaze coat with a dry brush, whisk broom, combs and other gadgets. You can use your finger for tricky texture effects and designs. If a glaze coat becomes too tacky for clean working, it can be wiped with a cloth moistened with naphtha.

General technique: Regardless of how you do this shading, highlighting or antiquing, the work should not be overdone. On clear finishes especially, any shading or highlighting should be soft. A combination of methods is sometimes useful. For example, it is nearly impossible to spray-shade carvings, but it is very easy to apply pigment stain or glaze and then expose highlights by wiping. On the other hand, the spray gun is excellent for shading panels and table tops. Turnings are best treated by wiping since a simple run-over with a rag from end to end will automatically highlight the bulbous portions.

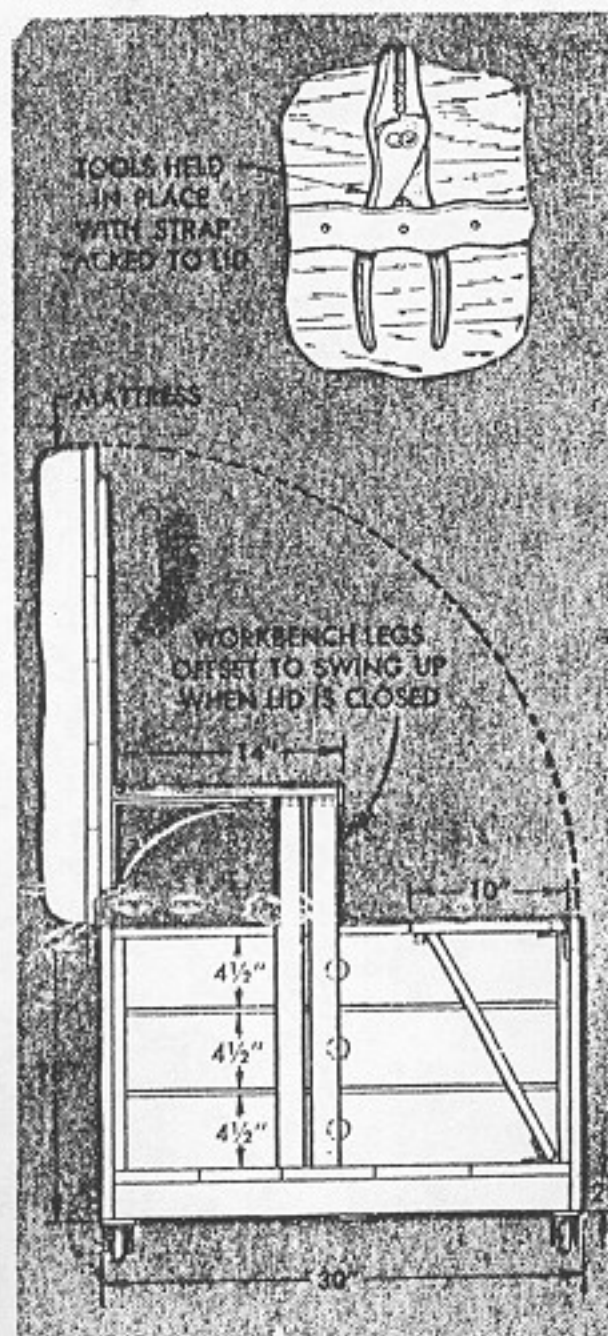
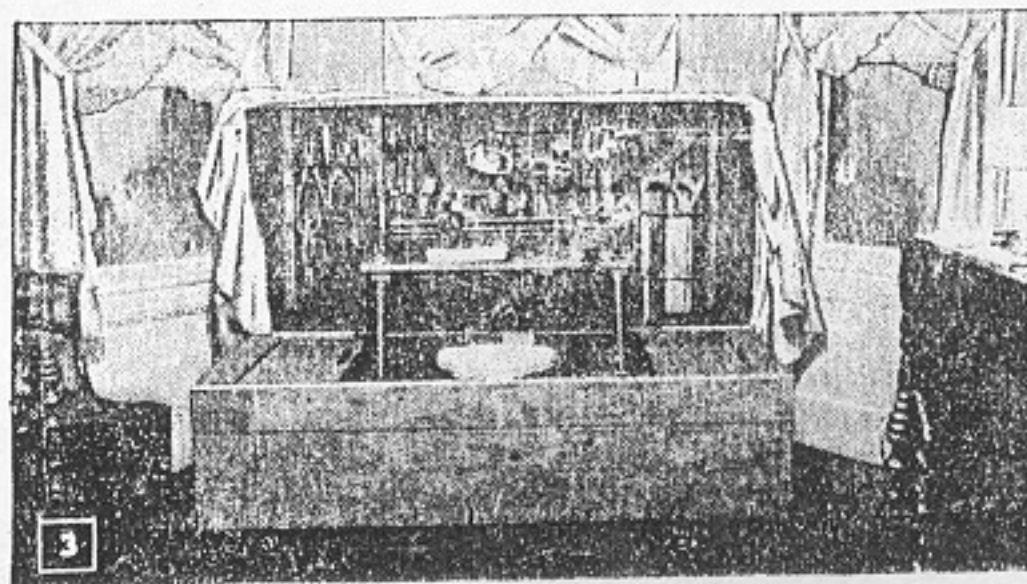
APARTMENT WORKSHOP

AFTER having had a complete basement workshop for many years, I was like a fish out of water when we moved into

an apartment. Trying to carry on by using the kitchen table as a workbench and having to stow away everything each time



No one would suspect that this studio couch houses a complete "workshop." Just lift the cover and presto!—there it is all before you—everything in readiness to begin work. No time is wasted putting things away

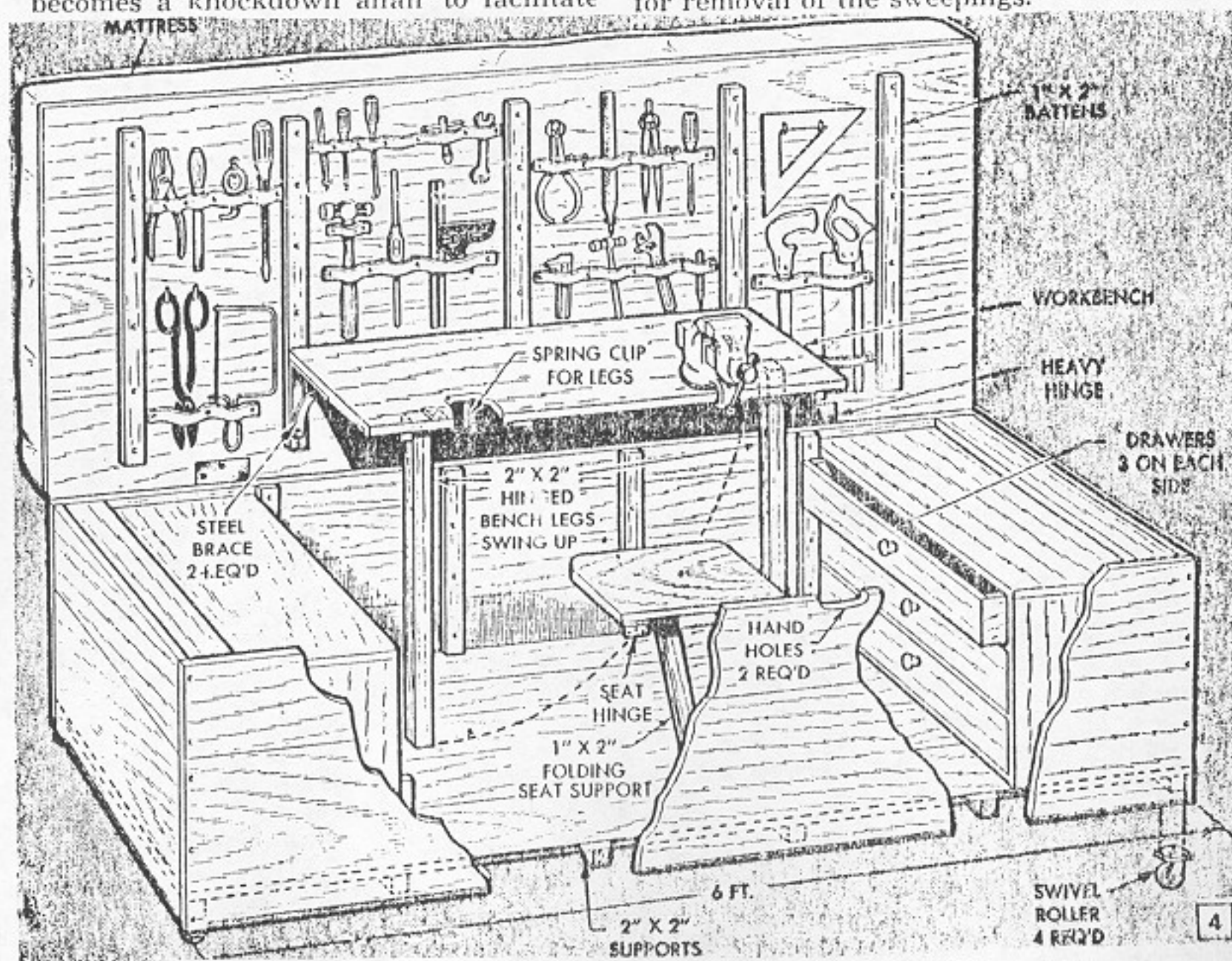


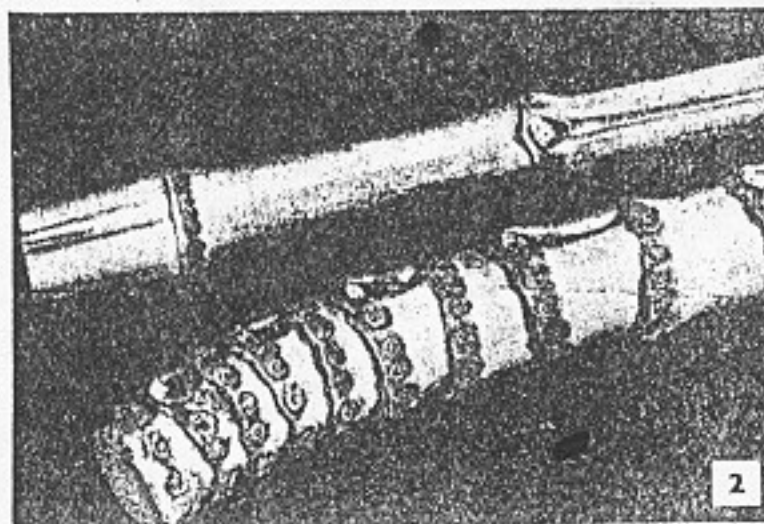
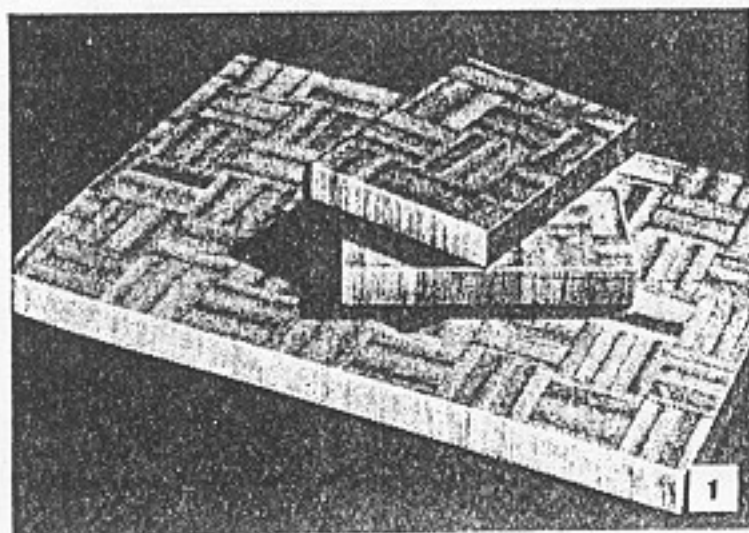
led me to build the portable, self-contained workshop pictured in Figs. 1 and 3. Not only does it solve the problem of a place to work with everything at finger tips, but it can be transformed quickly into a comfortable and attractive studio couch by simply closing the cover as shown in Fig. 2. There's really nothing to making it. Fig. 4 will give you a good idea of the construction which amounts to making a large box with a hinged cover and upholstering it with a mattress and slip cover. I used inexpensive, common-grade lumber, although $\frac{3}{4}$ -in. fir plywood could be used. This would eliminate the work of building up the sides, top and bottom with battens. Notice that the bottom of the box rests on 2 by 2-in. sills, equally spaced, and that a caster is fastened to each corner.

Each end of the box is fitted with a removable three-drawer cabinet, which is made separately and slipped into place. For these you may be able to purchase a ready-made chest of the unpainted variety, such as is sold in large department stores, and adapt it to fit the box, or the drawer compartment of a discarded piece of furniture might do. It wouldn't be necessary for them to extend the full width of the box either. Regardless, the cabinets should simply set in place so that the whole thing becomes a knockdown affair to facilitate

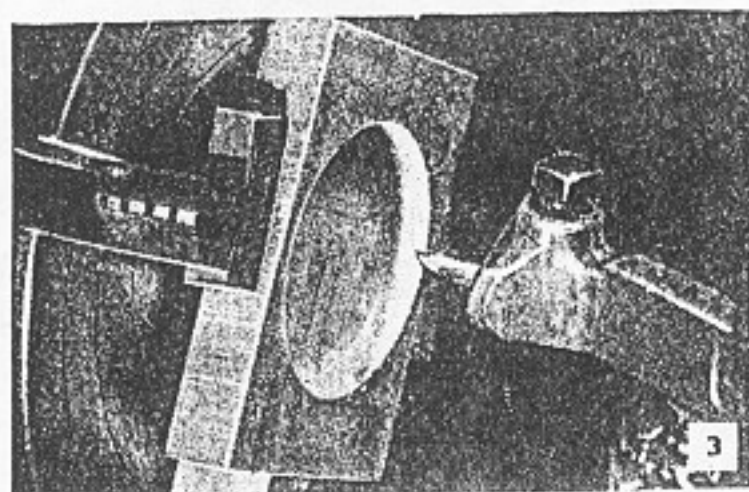
moving. I used flathead screws in assembling the box, and loose-pin hinges in attaching the cover so that it could be dismantled without too much trouble. The side view in Fig. 4 shows how both the workbench and seat are hinged to fold compactly. Regular metal shelf brackets support the bench top rigidly at right angles to the cover, and the legs are hinged offset to allow them to nest side by side when folded. Midget-type power tools such as a lathe, saw, drill press, etc., are ideal for use in this "shop." Mounting can be such as to allow the machines to be quickly interchanged, and there's ample room to store them in the bottom of the box. A piece of linoleum on the floor of the box will prevent sawdust from seeping through the joints of the boards.

The top is fitted with a standard cotton mattress, 30 by 74 in. This was spot-tacked around the edge to hold it in place and then covered with a slip cover having a pleated flounce. Note the hand holes that are cut in the top edge of the box at the front. This allows you to get a grip under the cover to raise it. Although not shown, a cleanout drawer in the bottom of the box, or a trap door, would facilitate removing shavings and sawdust. This necessitates raising the box higher off the floor to provide access for removal of the sweepings.

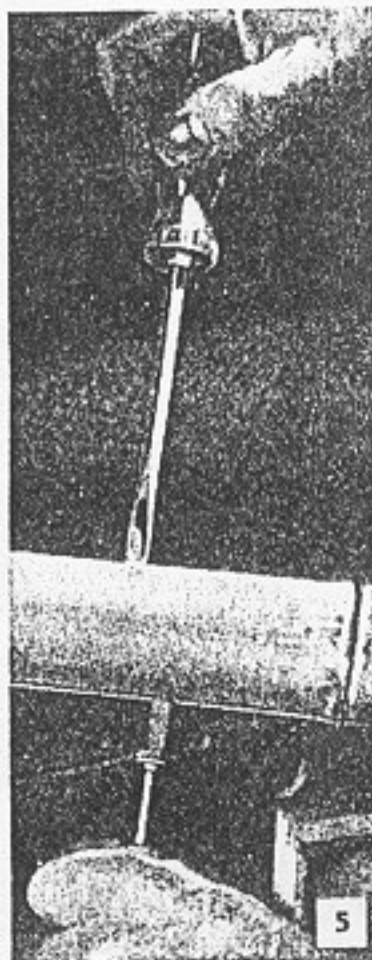
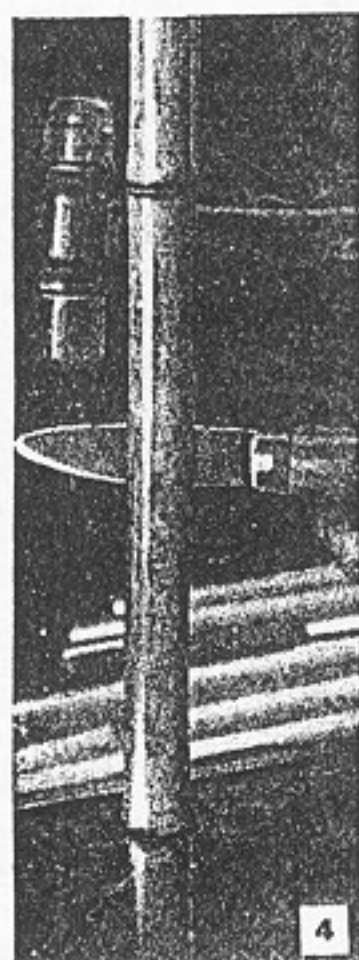




BAMBOO PROJECTS



A cavity can be made for paper-clip tray by turning bamboo parquet paneling on a wood or metal lathe, as above. To split bamboo stem, start it with knife and hammer as below left. Then use two screwdrivers (below right) to make split progress to second saw cut

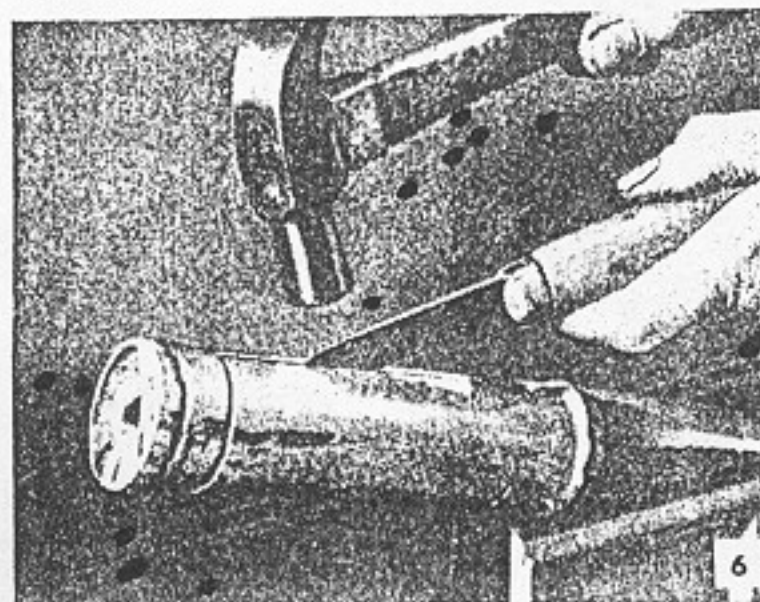


BAMBOO is one of the most widely used craft materials in the world, yet is rarely seen in American workshops. Most craftsmen, having seen bamboo only in fishing poles, do not know there are more than 1000 varieties of the plant, which is really a grass. Bamboo is enjoying a vogue, however, among handcrafters who appreciate the beauty, durability and utility of this ancient material.

Bamboo for craft purposes is obtainable at most hobby shops in stems (called culms) 6 in. or more in diameter; in roots or root stems (called rhizomes) used for handles and carvings, and in husklike sheaths suitable for weaving. Bamboo also comes in plywood and parquet panels.

In using bamboo, craftsmen should learn to exploit fully its natural shape, color and texture. The tubular stems, however, may be split, sawed, turned or otherwise worked. The pronounced one-way grain

After two saw cuts have been made, split bamboo by driving knife blade into each edge of the lid section



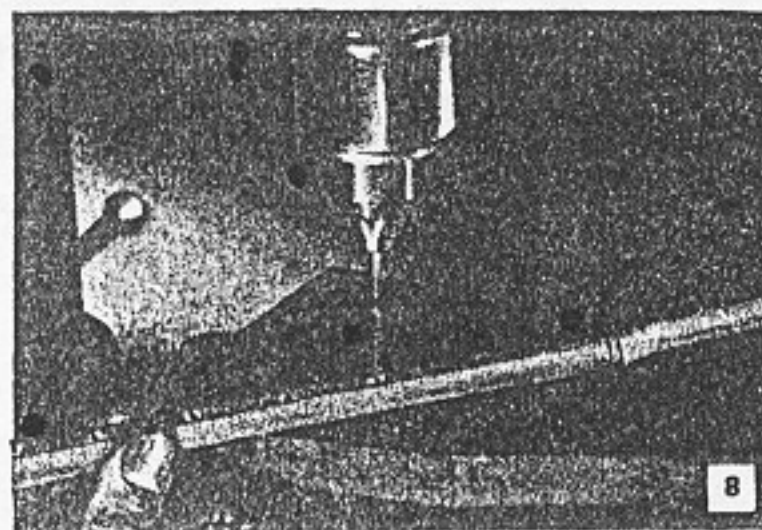
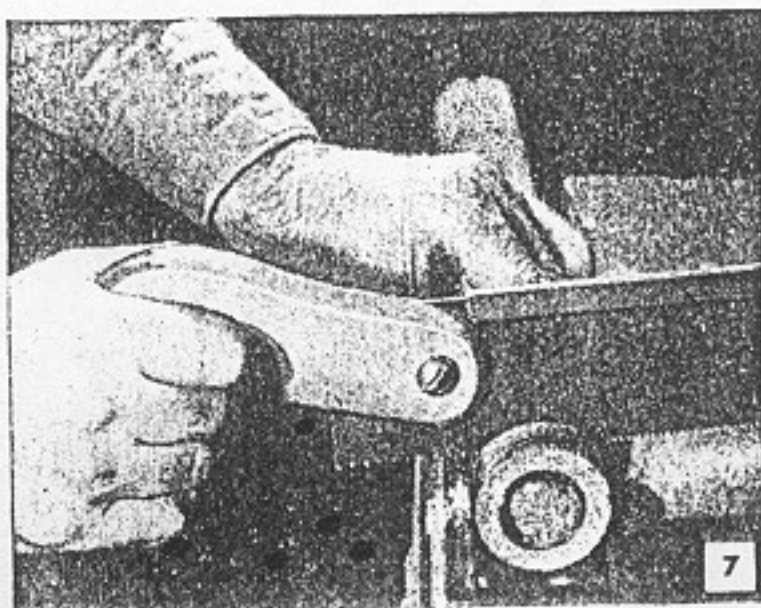
which makes bamboo stems so easy to split also poses some problems in fastening. It is advisable, therefore, to drill holes for all screws, bolts and other fasteners used.

Bamboo stem has a hard, smooth outer cuticle that forms a natural protective finish. Often it is desirable to remove this cuticle so that stain or dye used in coloring the bamboo can penetrate. Many adhesives will not stick to the stem surface until the cuticle has been removed. Also, scraping off the cuticle is an easy way to get rid of stains, shallow scratches and other marks that are unsightly. And it is said that bamboo from which the cuticle has been removed is less likely to split than that in its natural state. If a shiny finish is desired, the "decuticled" bamboo can be given a coat of clear lacquer, shellac or other similar protective material.

Bamboo materials are easily cut with ordinary woodworking tools, can be drilled and threaded like hardwood or metal and respond nicely to rasp (photo 9) and sandpaper. Tools should be sharp to minimize splitting and the formation of "whiskers," particularly in sawing. If a lathe is available, ends of stem sections can be squared accurately by chucking them and taking a facing cut (photo 10) with a keen-edged tool having considerable rake—like a tool used for aluminum turning. Bamboo stems, particularly the thinner ones, are readily bent to permanent curves by heating them with a torch, (as in photo 11) or over a gas burner. Care should be taken not to over-heat or scorch them.

The projects described here show but a few of the endless ways in which bamboo can be used in making decorative and useful articles. In some cases, ordinary fishing poles supplied the raw material. Forms such as the root stems and large culms are obtainable from dealers. Although bamboo is a well-known product of the Orient, it is

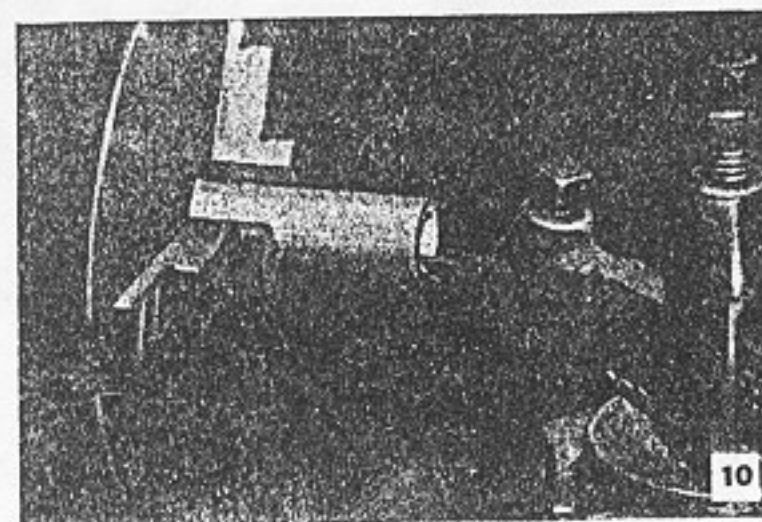
Lid for rod case is being cut out below. Cut is made 1 in. from end of each side, halfway through bamboo



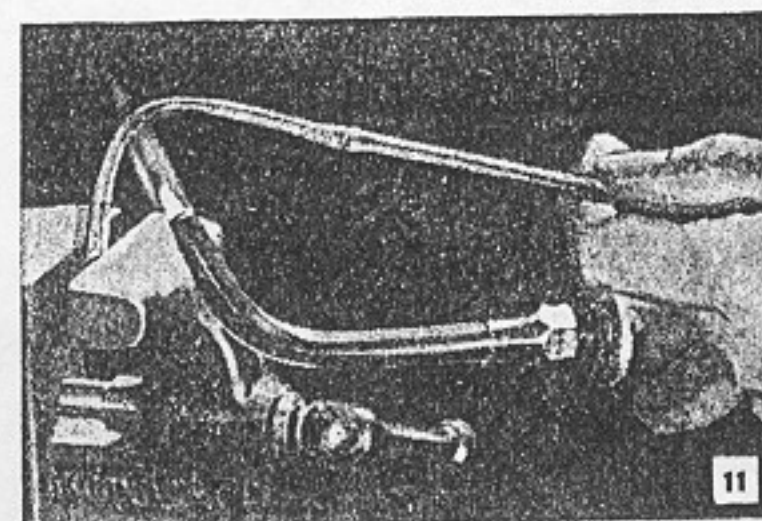
Procedure in drilling bolt holes in bamboo is shown above. Holes will receive brass bolts and wood screws

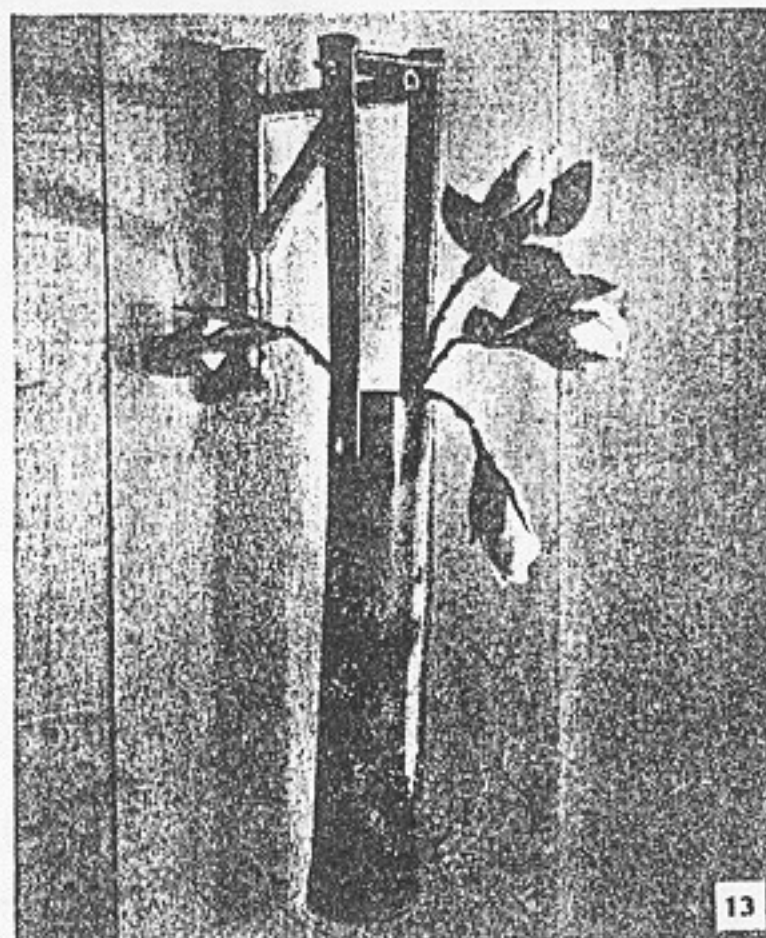
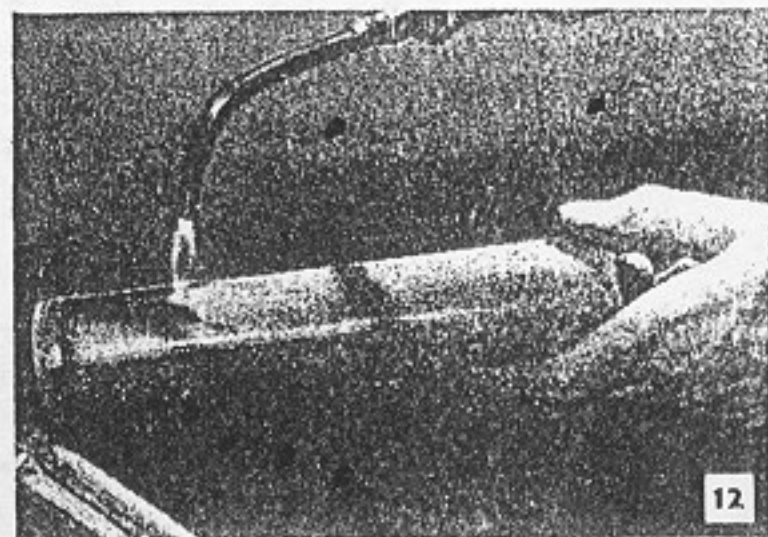
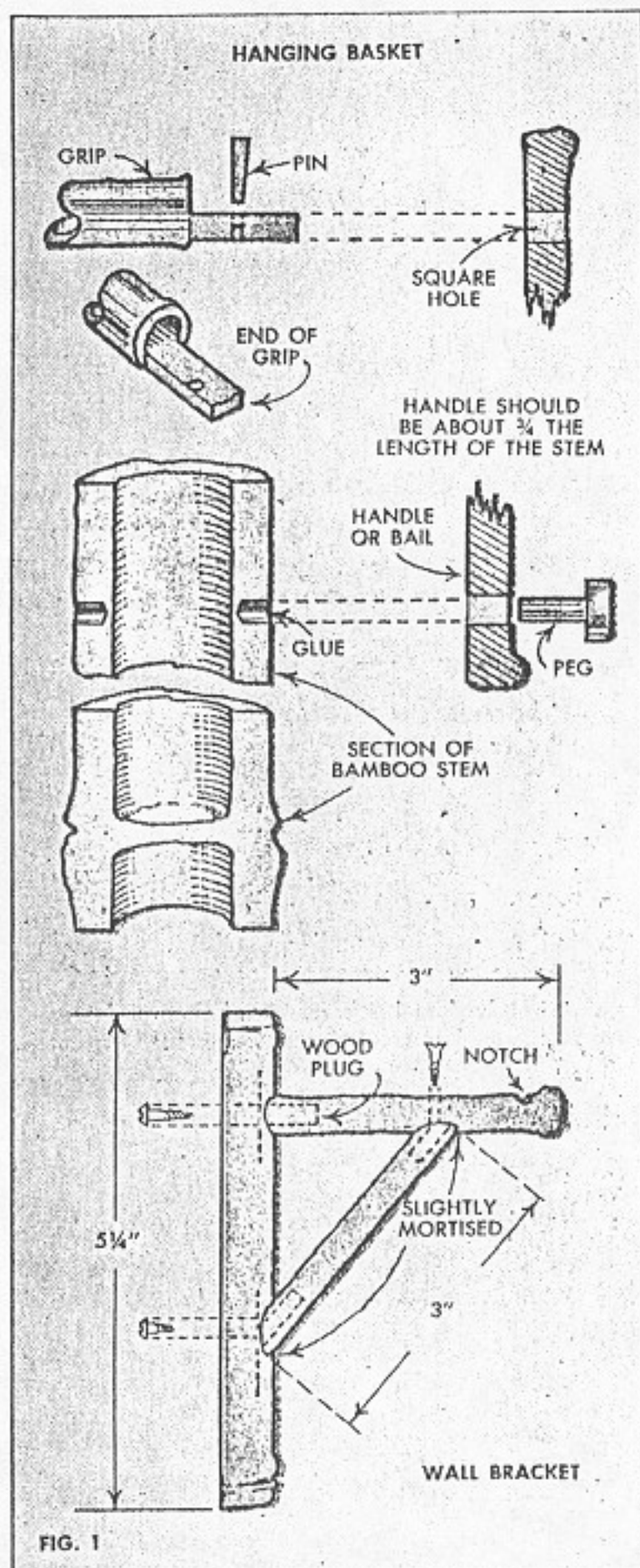


Bamboo can be faced either with a half-round rasp as shown above or with a lathe in manner shown below



Bamboo stem can be bent by heating it, as below, and applying the needed force. Then when bamboo cools, it stays put. Take precaution not to burn the material



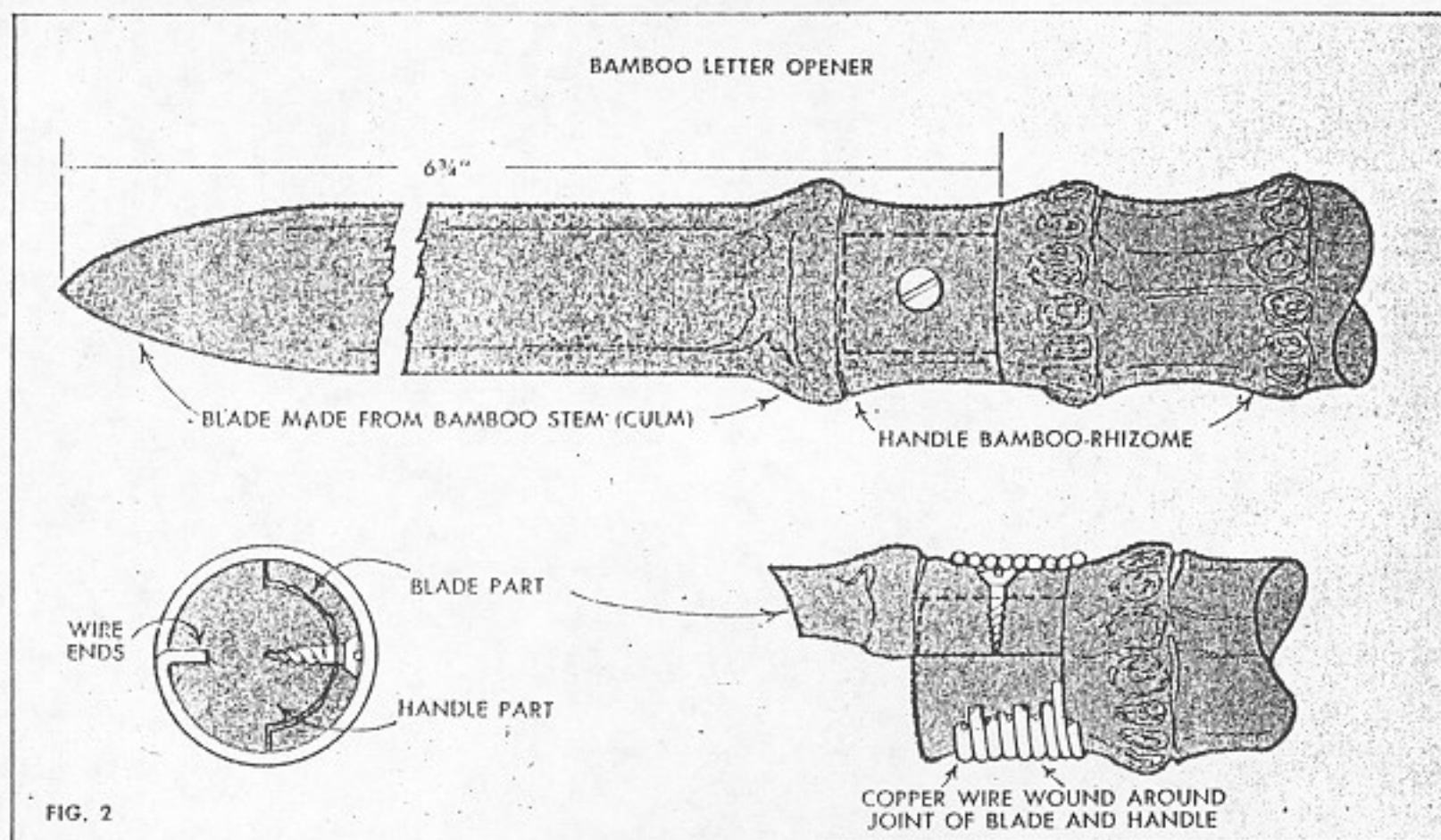


grown in such near-by places as the southern states and in Puerto Rico.

Hanging basket or vase: The body of this basket is a bamboo stem $1\frac{1}{2}$ in. or more in diameter, and the three-section handle or bail is made from pieces split from stem material 1 in. or so in diameter. Drill $\frac{3}{16}$ -in. holes near each end of the two longer bail sections. With a file, convert one hole in each piece into a square hole, to receive the squared ends of the grip, which are held in position with pins whittled from the same material. The bail is fastened to the body with bamboo pegs held in the body holes with glue. Complete instruction details are given in Fig. 1.

The outside of the basket and bail can be left in its natural condition or may be decorated by scorching lightly with a torch flame. The scorching can be in the form of a decorative pattern suggesting a vine, as shown in photo 12. If cut flowers are kept in the basket, make a sheet-metal lining to hold the water. Although the bamboo itself might be a fair container for water or may be treated with a waterproofing material, the use of a metal liner is advisable in all vases where cut flowers or living plants are to be placed. Photo 13 shows the completed hanging basket.

Wall bracket: For suspending the hanging basket or other object from a wall, a figure-four bracket like that shown in Fig. 1 is strong as well as decorative. The shallow mortised joints add to the strength. Screws used to reinforce the joints engage wooden plugs glued in the ends of the bamboo pieces. The plug at the rear of the horizontal section should, in particular, be

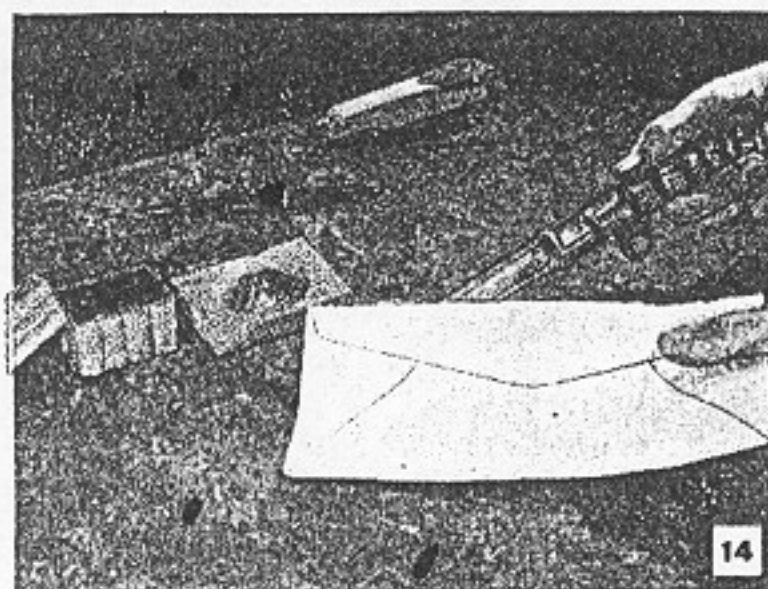


firmly fastened; a slender crosspin or peg is recommended for the purpose. This use of wooden plugs in ends of bamboo-stem sections is a common means of fastening. The plugs form a firm seating for screws, nails and dowels.

Letter opener or knife: A bamboo letter opener (photo 14) is a useful and durable desk accessory. The one shown has a blade fashioned from a piece of bamboo stem, while the handle is made from a slightly curved section of root stem, or rhizome. This rhizome, or runner, is an underground connection for bamboo plants and numerous roots extend from it. When these roots are trimmed off, decorative rings are left, each consisting of a row of little round spots composed of concentric circles. The root-stem handle can be used also for a knife or other tool, or for an umbrella handle or cane. Although the root stem looks like an ordinary bamboo stem at first glance, it has a solid core, while the aboveground stem is hollow and the joints are usually much closer together.

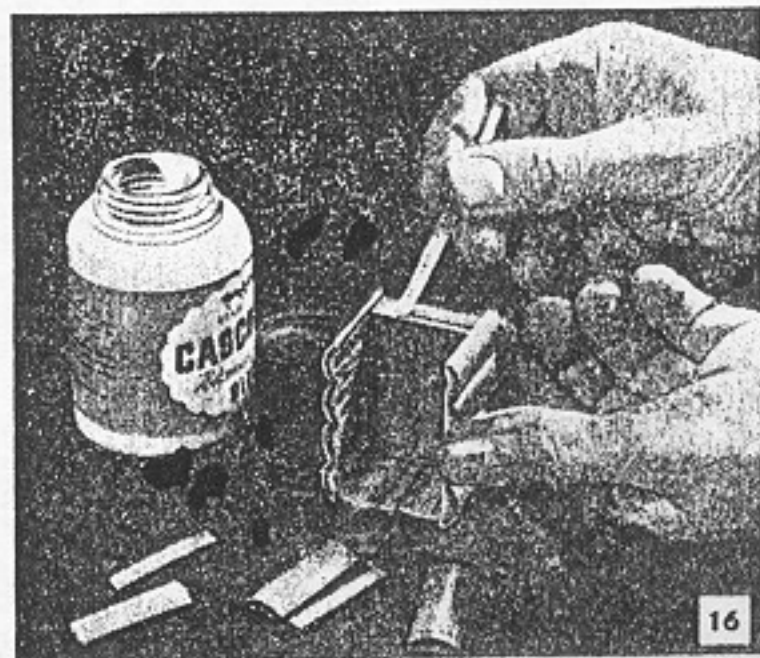
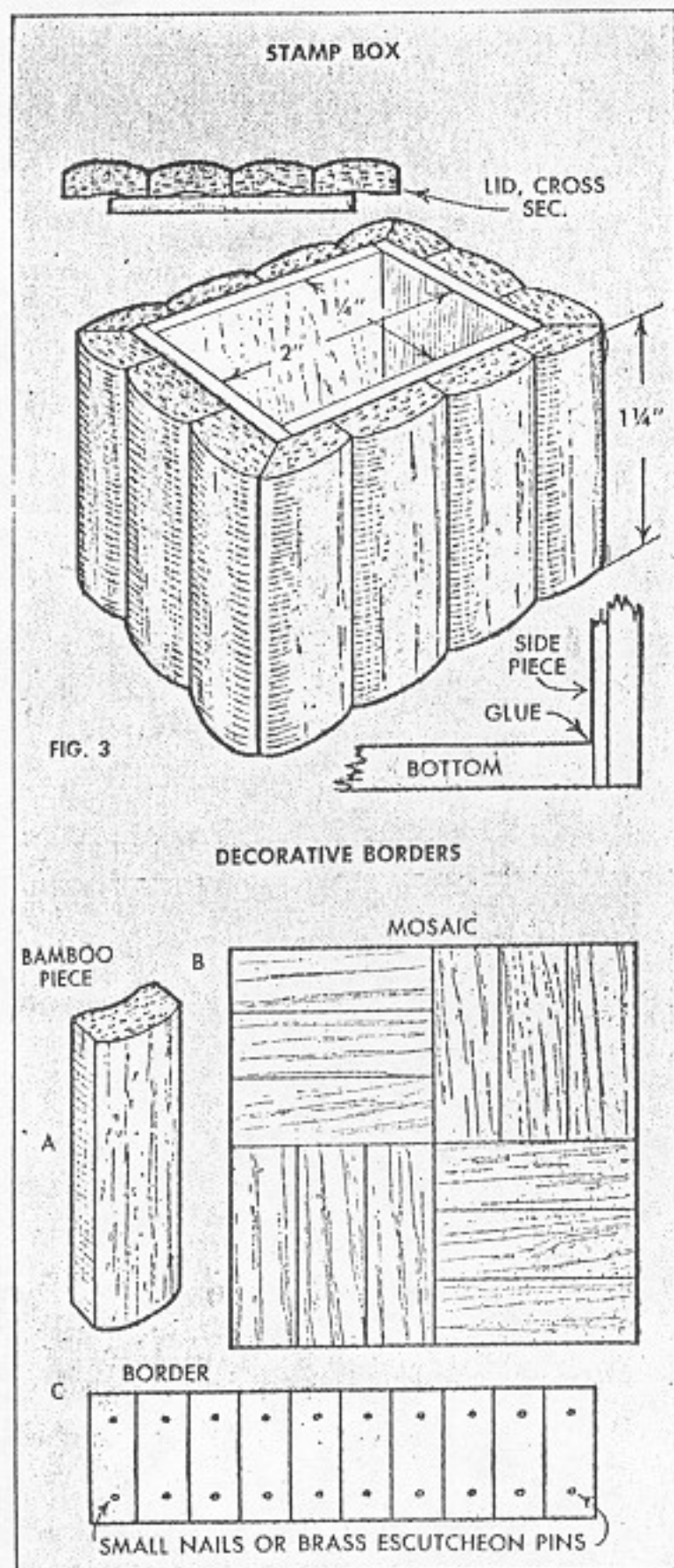
Cut the handle section to the desired length, about 5½ in. for a letter opener. With a fine rasp, smooth the rings formed by the root scars and finish with a fine sandpaper. With a small brush (photo 15), apply light oak or a similar oil stain to these rings, but do not stain the intervening portions of the root stem. Then give the entire handle a coat of clear lacquer. You can do this finishing either before or after the handle and blade are joined.

A half-round section of culm of the same diameter as the handle forms the blade blank. Shape the blade with a sharp knife



Letter opener, paper-clip tray and stamp box, above, are but few attractive objects that can be made from bamboo. Below, root scars on handle are brought out by staining. Then finish the handle with clear lacquer





and sandpaper. Near the blade base there should be a joint, with a $\frac{3}{4}$ -in. extension beyond. Mortise this into the handle as shown in Fig. 2. Use glue and a brass wood screw to fasten the parts, and finish with a winding of copper wire or something similar. Lacquer the wire and blade.

Stamp or trinket box: By splitting a bamboo stem to yield two, three or four sections of equal width, you obtain pieces with one rounded surface, which can be used in making stamp and trinket boxes, decorative borders, mosaic patterns for wall panels and similar arrangements.

The stamp box is assembled by gluing such strips to a rectangular plywood bottom as in photo 16, sanding top and bottom ends of the bamboo pieces after the adhesive has set. Line the interior with colored paper. Each bamboo piece is planed on the flat side and edges to make it uniform and true. Such planing is easiest done on long pieces before they are cut into short sections. The box lid consists of three bamboo strips (see Fig. 3) glued to a rectangular piece of $\frac{1}{8}$ -in. composition wood that fits inside the box opening. By varying the widths of the bamboo strips, various patterns can be worked out. When an interior lining is to be used in such a box, the shallow grooves resulting from the interior bore of the bamboo stem are not objectionable in appearance.

Bamboo pieces of similar shape can be used to make borders and mosaic patterns, as shown in Fig. 3, B and C. Fig. 3A shows the general shape of such a piece. A simple border, at C, is formed by gluing or nailing strips side by side and can be used to decorate shelf edges, picture frames and so on. A checkerboard mosaic pattern, B, is easy to assemble. When used on a wall, it could have a border like that shown at C.

Parquet paneling: This unusual craft material is made by gluing together short pieces of bamboo stem to form a solid panel, the end grain being arranged to produce a checkerboard pattern (photo 1). Parquet paneling is imported, a typical size measuring $\frac{1}{2} \times 1 \times 1$ in. It has a lacquer finish and can be used without further manipulation for wall paneling, table tops, hot-dish pads and many other articles. Because of its interesting structure and pattern, this paneling is an interesting material for making ash trays, trinket trays, coasters, vanity cases, powder boxes and other things involving either turning or carving.

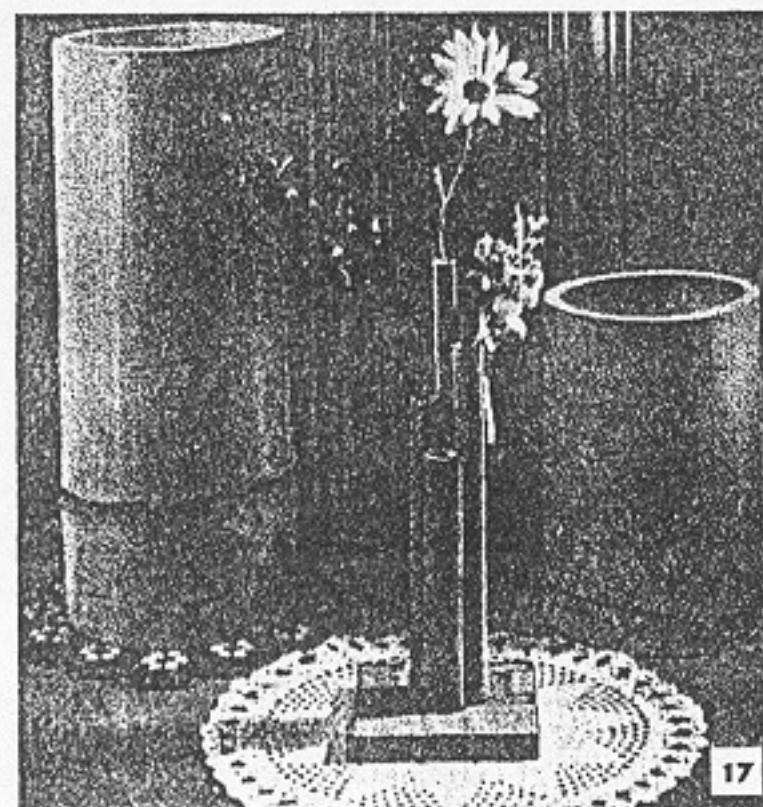
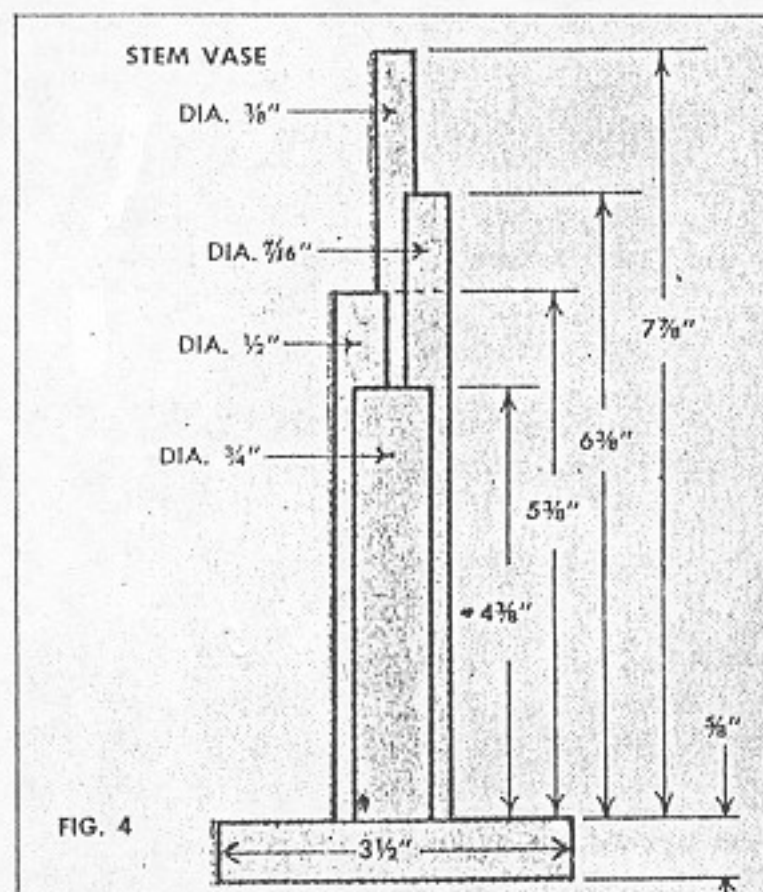
Perhaps the simplest useful object is made by mounting a square or rectangle of the material on a lathe faceplate or in a chuck and turning a cavity that extends to within $\frac{1}{8}$ in. or so of the opposite surface. Polish with fine sandpaper and apply lacquer or other protective finish. The delicate

coloring of the material is preserved by a clear finish coat. However, you can use oil stain, thinned colored lacquer or various other colored protective materials to add variety. As the piece comes straight from the lathe, it makes a useful trinket tray or coaster. A set of bamboo coasters makes a novel gift which almost anyone would appreciate. Add a half-round piece of bamboo stem 1 in. or so long, and you have an attractive ash tray. The finish for the ash tray should be of a type that will not scorch or burn readily. A lining of thin metal or a glass tray of a suitable shape may also be installed in the bamboo tray.

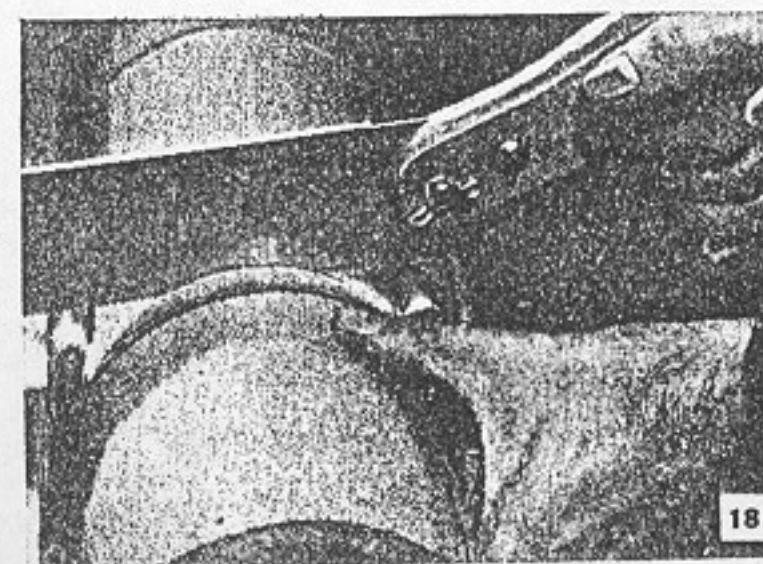
Stem vase: The parquet material makes an attractive base for a stem vase formed by grouping three or four stem sections of different lengths and diameters (Fig. 4). The stems can be fastened to the base by slipping their lower ends over glue-coated wooden plugs secured to the parquet paneling with wood screws. Each stem should be whittled or filed so it touches at least one of its neighbors, and the areas of contact should be scraped to remove the cuticle so glue will stick to them. The finished vase is shown in photo 17. If the vase is to be used for artificial flowers, no interior work need be done other than drilling through any joint diaphragms that might be present. If cut flowers are to be displayed in the vase, install waterproof metal tubes inside the stems.

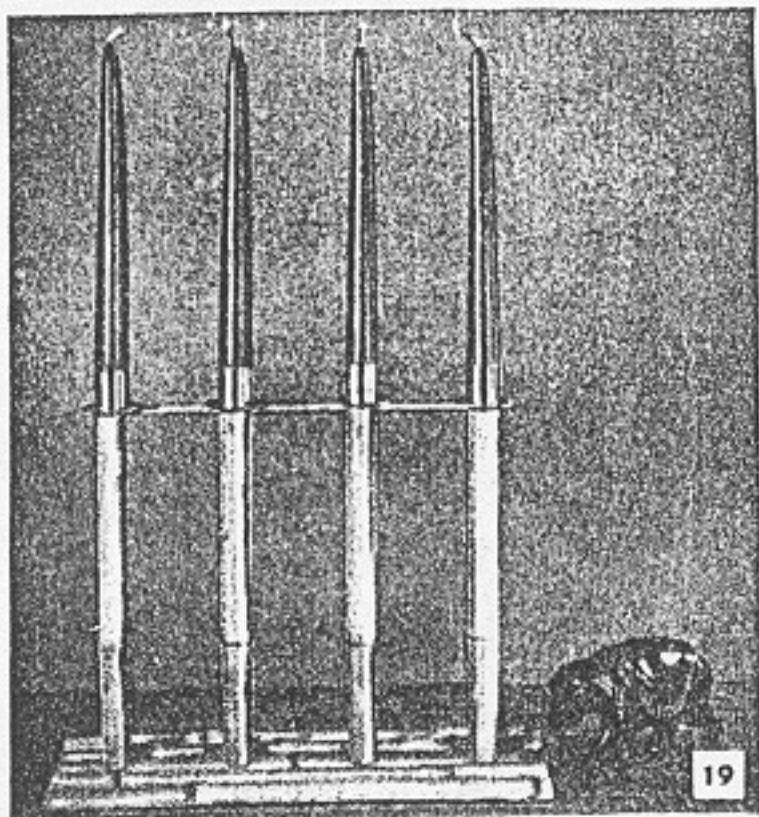
Large-diameter stems: Simply by sawing large stems (photo 18) to various lengths, with joints near one end to form bottoms, you produce attractive containers (in background of photo 17) for pencils, brushes, cigars, cigarettes, flowers and stick candy. No special finish is required, other than smoothing the sawed edge. In the Orient, such stem sections are used for vases and brush holders and often are decorated by elaborate carving. Some such examples are very old and are almost black in color. You could imitate such aging by using a dark brown or black stain after the cuticle has been removed.

Modern bamboo candleholder: A graceful holder (photo 19) suitable for a table centerpiece or as a decoration anywhere else is assembled mostly from bamboo stems about $\frac{3}{4}$ in. in diameter. For the upright portions, stems should be selected for uniformity of diameter and for straightness. The base consists of five half-round pieces split from similar material, although uniformity is not so important. Uprights are fastened to the center base strip by screws engaging wooden plugs. Ends of the uprights should be made concave (photo 20) with a rasp, to fit around the base strip. Glue and nail this strip to a $\frac{1}{8}$ -in. rectangular panel of plywood or composition ma-

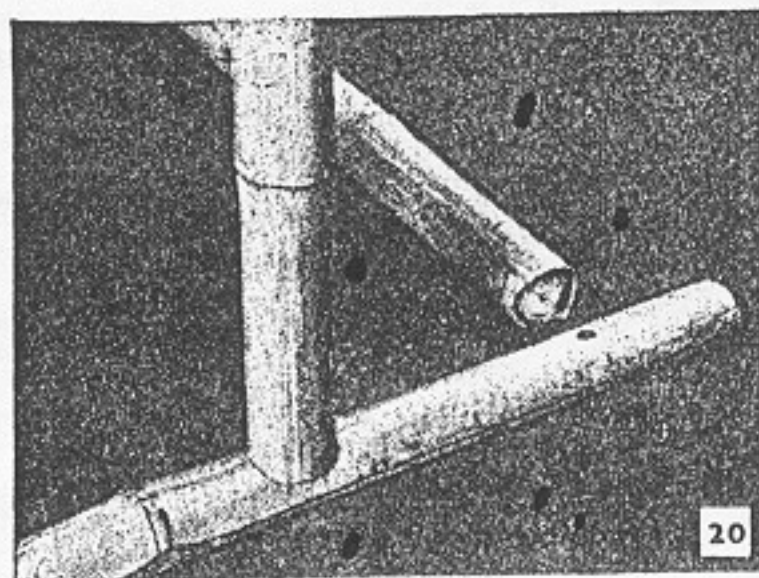


To cut bamboo stem, pencil in line for guide, clamp stem in vise with pads between it and jaws, then cut with ordinary handsaw or hacksaw, as is shown below





Lower end of each candleholder upright is equipped with wooden plug and filed concave to fit base strip as shown below. A wood screw unites pieces. Hole in base strips should be oversize to permit alignment



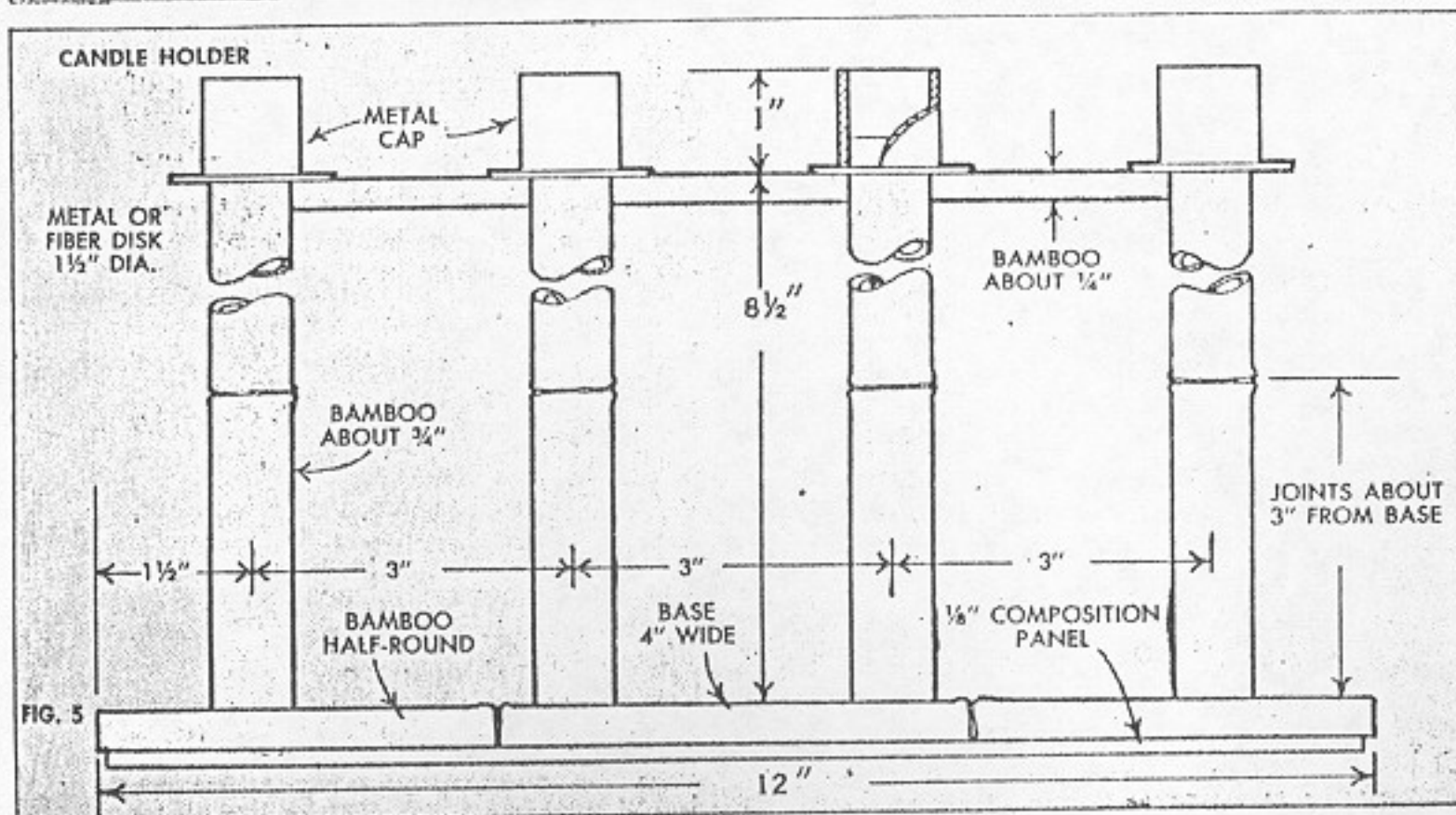
terial, and glue the other base strips alongside it.

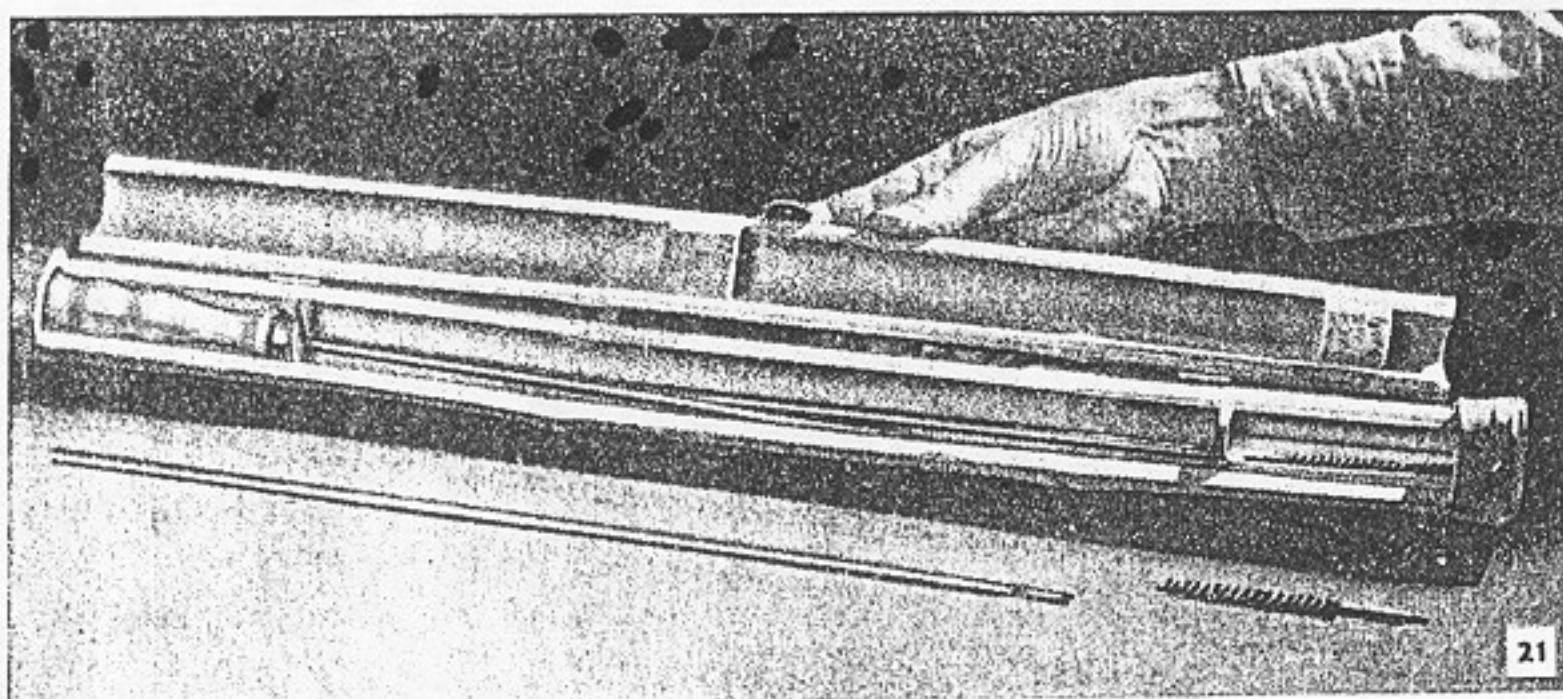
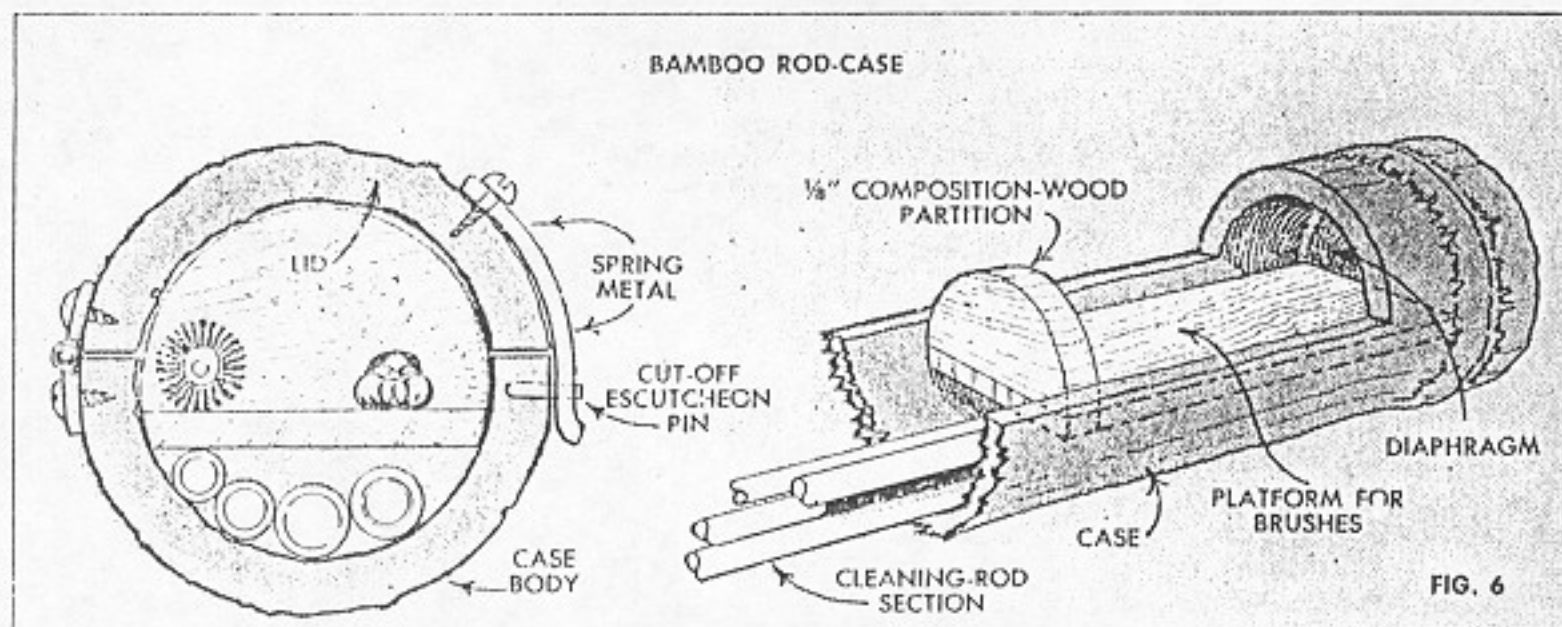
Upper ends of the uprights are joined by lengths of $\frac{1}{4}$ -in. bamboo stems secured with glue and are capped with metal rings and metal or fiber collars (washers) as shown in Fig. 5. The rings on the model were machined from scrap aluminum tubing, but can be made by bending and soldering sheet metal. Proportions of the holder shown were calculated for best appearance, even to the positions of the stem joints in the uprights. Dimensions are shown in Fig. 5.

Bamboo rod case: An Oriental fishing-rod case was the inspiration for the gun-cleaning rod case shown in photo 21. Such a case is excellent for holding either fishing or gun rods, or slender objects of any kind.

A piece of bamboo stem $1\frac{3}{4}$ in. or greater in outside diameter and of whatever length required is the starting point. Whenever possible, cut the piece so joints form natural end closures. Otherwise, install wooden plugs. For fishing-rod handles, you may have to hollow out a spot here and there. Sometimes the partitions formed by joint diaphragms can be left in place; at other times you will have to glue in plywood partitions where required. The lid is formed by making two saw cuts part way through the stem and carefully splitting out the section between them. See Fig. 6 for construction details.

Lawn-chair seat and back: Bamboo is considered a very durable material and is able to withstand rain and sun well. Therefore, it seems to be an ideal material for outdoor furniture. Bamboo obtained from cheap fishing poles was used in making the seat and back for the steel-framed lawn chair shown in photo 22. The seat consists



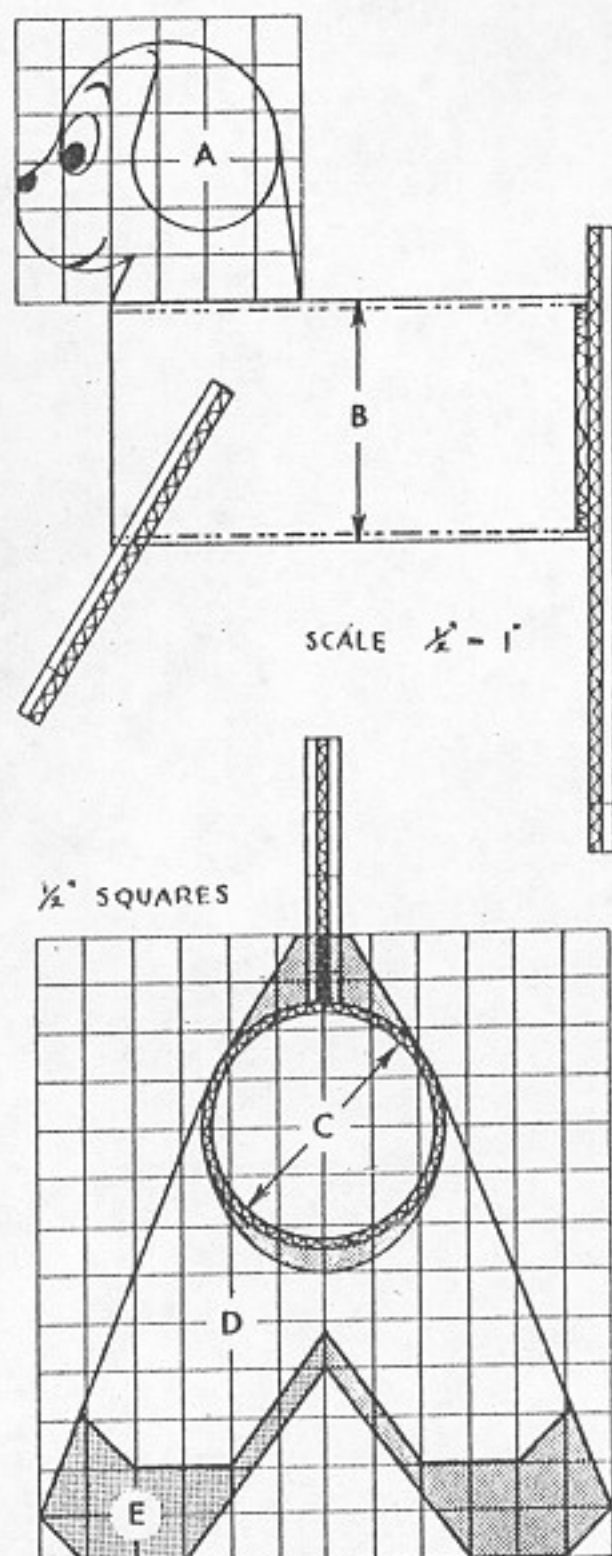


of parallel pieces of whole stems, attached with nonrusting bolts to crosspieces. It is used with a cushion, so springiness and smoothness are secondary. Although the back panel of the sample chair was made from bamboo splits fastened with brass nails to oak crosspieces, it was found that the nails had a tendency to loosen. Therefore, screws should be used instead of nails, and the hole at one end of each strip should be oversize or oval so the strip can move with respect to the crosspiece without loosening the screw.

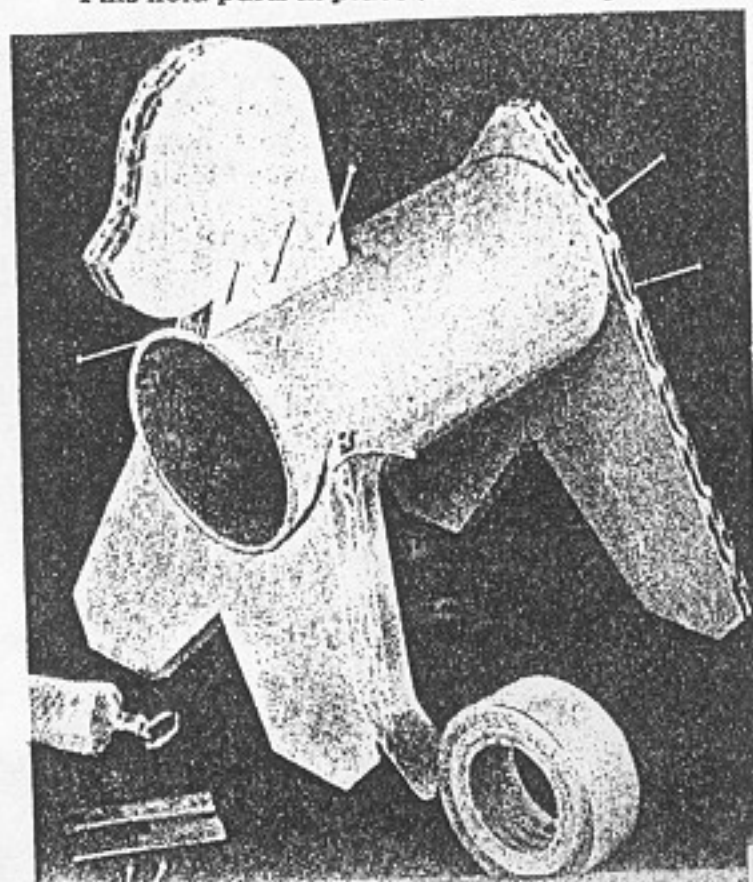
Bamboo is one of the most durable materials the craftsman can use. The people of Malaya, India, China, Japan and the Philippines use bamboo sections for posts and rafters of houses. Bamboo, either whole or split lengthwise into strips, also provides material for walls, floors and roofs. Some homes are finished entirely in bamboo. Because of its wide use, bamboo is cultivated in groves by the people of the Far East. In some localities, bamboo articles are subject to damage by powder-post beetles, which bore holes and hollow out spaces, producing a fine powder as a by-product. Other than these beetles, bamboo has few enemies.

Gun-cleaning rod case above is made from piece of 1 3/4-in. bamboo stem. Similar case can hold fishing rod, arrows or other slender items. Seat and back of chair below are made from old bamboo fishing rods





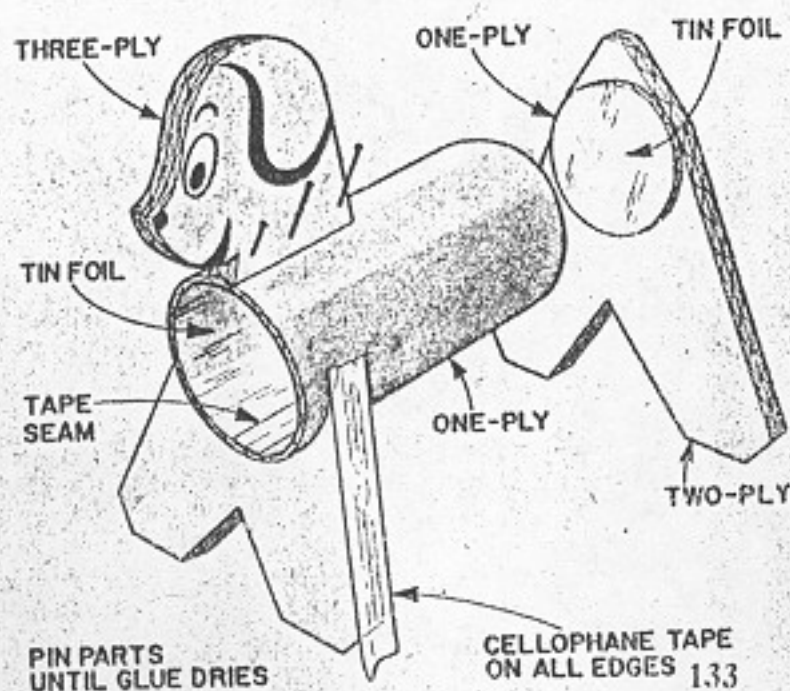
Pins hold parts in place (below) until glue dries after which the holder is lacquered white and face painted.



Baby Bottle Holder

By Joseph Argenziano

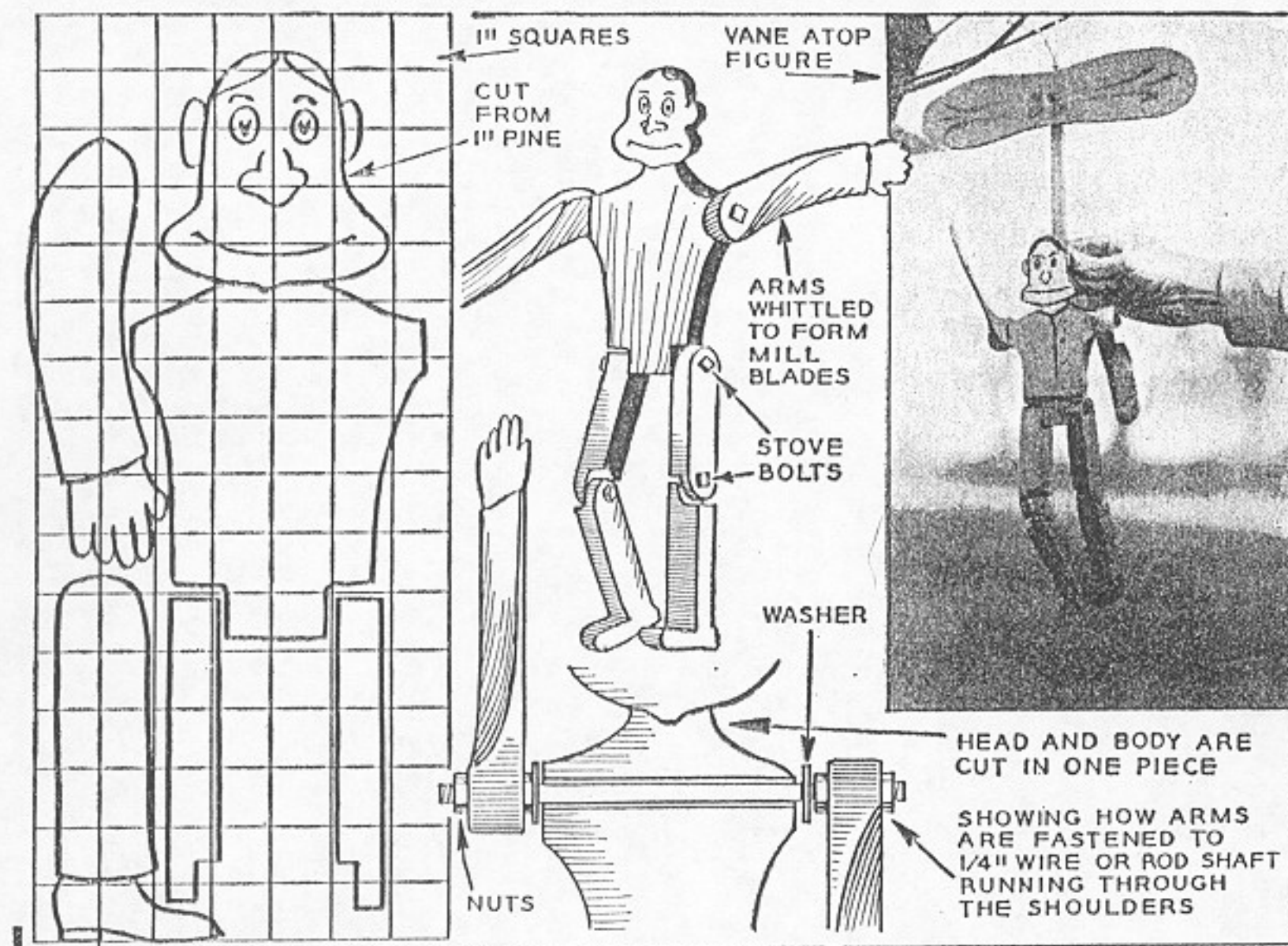
A SCISSORS, cellophane tape, tin foil, pins, some glue and a couple of sheets of corrugated cardboard are all you need to make this novel bottle holder. First enlarge patterns to actual size and then trace all parts on cardboard. Where two or more surfaces are cemented together, the corrugations should run in opposite directions for strength. Round edges for safety. •



WINDY WILLIE

THE HANGING WINDMILL

MECHANICS ILLUSTRATED JUNE, 1939

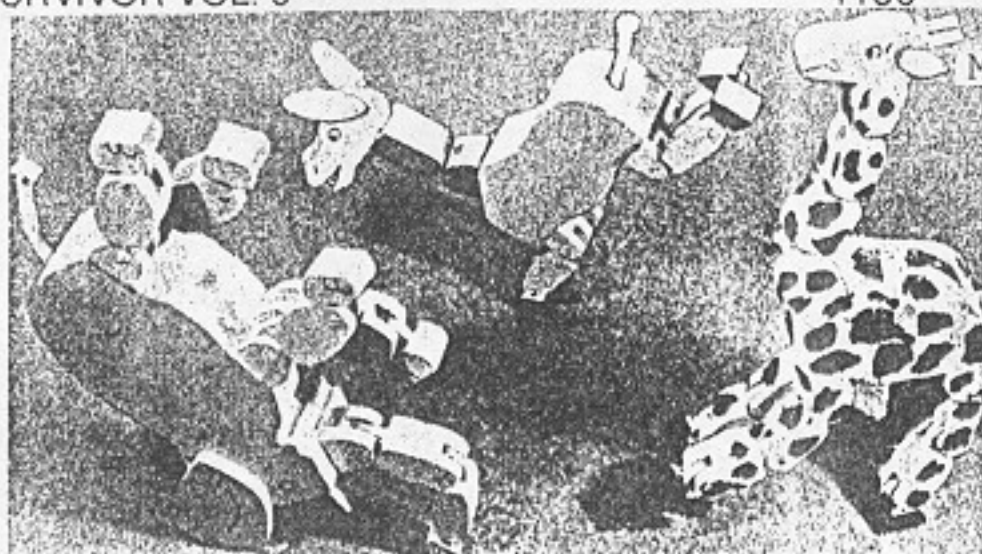


ALTHOUGH animated toy windmills are increasing in popularity every year, there never seems to be a great enough variety of the designs, particularly of the comic variety, to satisfy the windmill "fans." Here is Windy Willie, a novel comic one, which, while having no intricate moving parts to complicate construction, is still so original that it attracts more attention than many of the more complex type.

As will be seen from examination of the photograph and detailed construction drawings above, the little mill is designed to hang from a tree limb or other support, and to swing freely in the wind. The figure is made of one-inch pine with the head and body in one piece. The arms are whittled to form the mill blades, and fastened to a shaft running through the shoulders. The legs are in sections, joined together with stove bolts, and when the mill is turning, the jarring of the entire figure causes these to jig in a comical manner.

Cut the figure from the wood with a coping, jig or scroll saw, first transferring the accompanying squared design, full sized, to the wood and using it as a guide. Whittle the arms in regular windmill fashion, and use a length of quarter-inch iron wire or rod threaded to receive the nuts, for the shaft. The vane arrangement, attached to the back of the head by a wooden stick (see photo), keeps the figure turned more or less to the wind so the arms will swing. As the figure swings it will necessarily be quite active, and the arms will revolve intermittently.

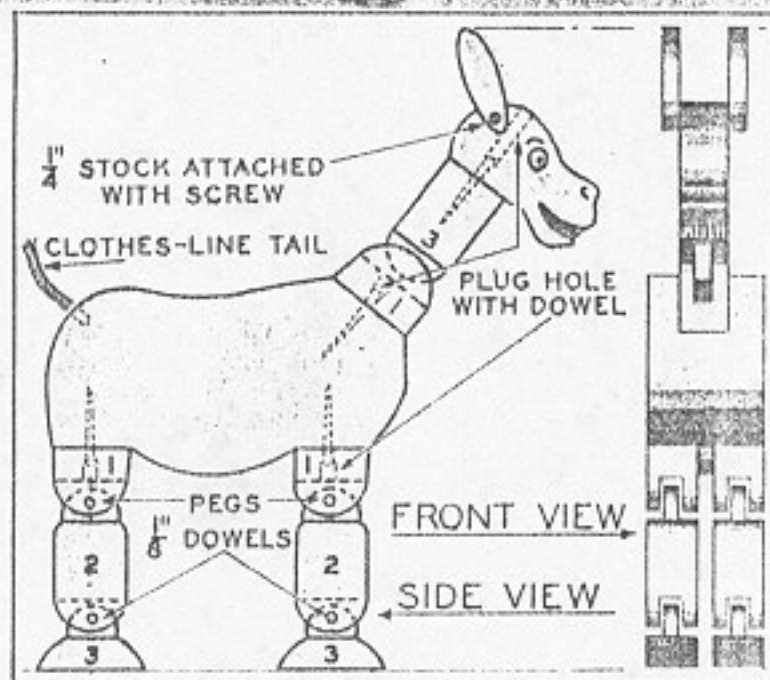
After Windy Willie has been assembled and tested, decorate him in gay enamels and paint in his face, hands, etc. For a more permanent job, his features may be traced onto the wood before painting, then carved out with a sharp knife. Several Windy Willies, with various comic faces, will make attractive and novel decorations for your trees or terrace.—Paul Hadley.



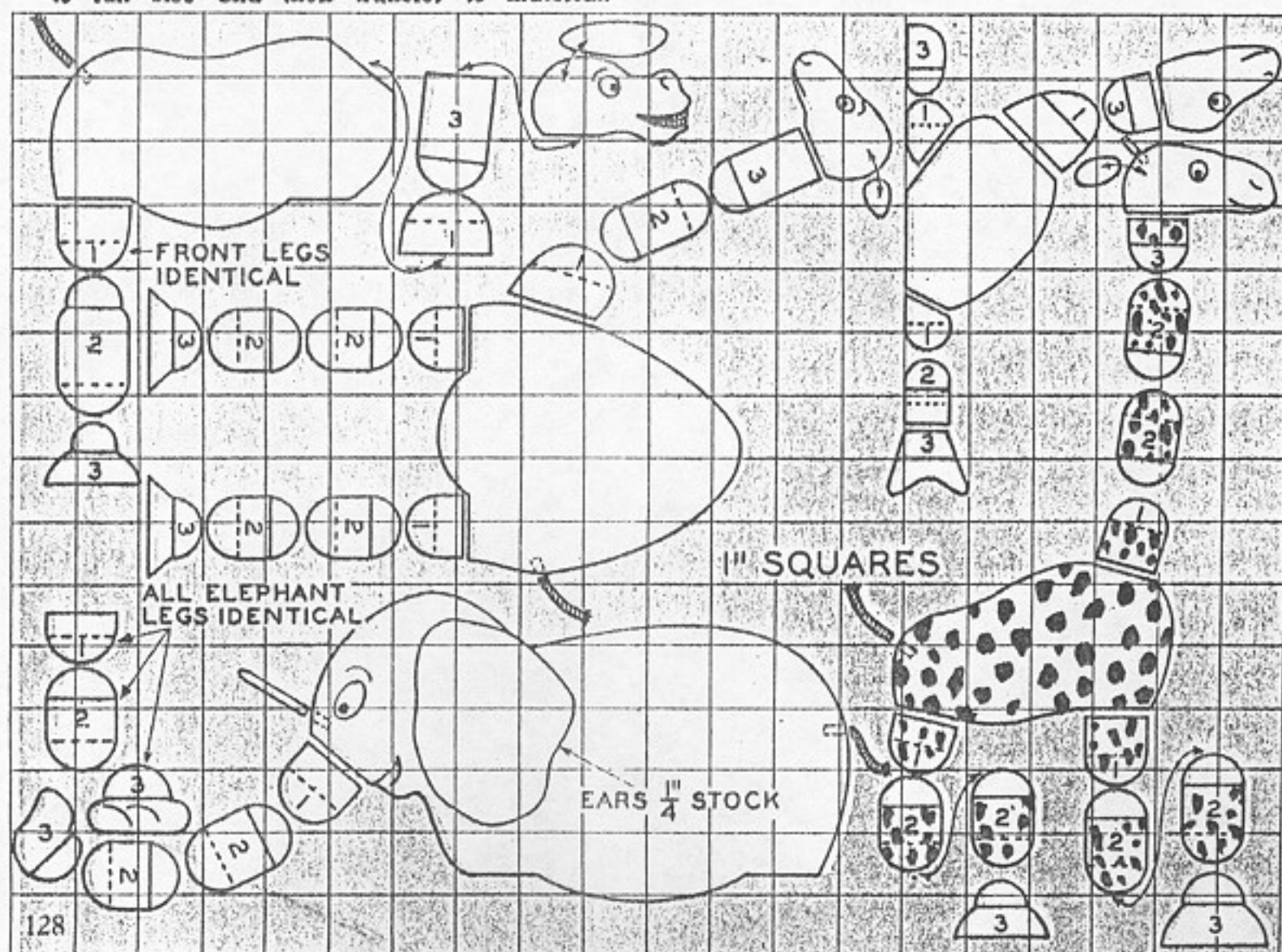
Jointed Circus Animals

An elephant, mule and a giraffe for the youngsters.

THERE is virtually no limit to the number of poses these limber animals can assume, and any young ringmaster (and some not so young) will enjoy putting them through their paces. The bodies are cut from $1\frac{3}{4}$ in. stock while all other parts, except the ears, are $\frac{3}{4}$ in. material. The legs and necks consist of a series of pieces put together with tongue and groove joints. The No. 1 pieces have a groove along one edge, the No. 2 pieces have a tongue along one edge and a groove along the other while the No. 3 pieces have only a tongue. Dado a length of 2 in. wide stock for each group, outline each part on the material and then jigsaw along the line. For assembly, drill holes through joints and insert $\frac{1}{8}$ in. dowel.



Outline of all parts is shown below. Enlarge to full size and then transfer to material.



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